United States
Department of
Agriculture

Soil
Conservation
Service

Bismarck
North Dakota

FLOOD PLAIN MANAGEMENT STUDY EAST FORK SHELL CREEK IN MOUNTRAIL COUNTY

Prepared for the City of Parshall, North Dakota

In Cooperation with the Mountrail County Water Resource District, Fort Berthold Soil Conservation District and the North Dakota State Water Commission

APRIL 1984

FLOOD PLAIN MANAGEMENT STUDY

FOR THE

EAST FORK SHELL CREEK

AND

ADJACENT CRITICAL FLOOD PLAIN AREAS

IN

MOUNTRAIL COUNTY, NORTH DAKOTA

Prepared By

United States Department of Agriculture
Soil Conservation Service
Bismarck, North Dakota

For the

City of Parshall

In Cooperation with the
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April 1984

FORWARD

This report defines the flood characteristics along and adjacent to the East Fork Shell Creek in Mountrail County, North Dakota. Land uses along the stream are transportation, residential, commercial, agricultural, recreational and industrial. Despite moderate agricultural damage by floods in previous years, there is increasing pressure for development of the flood plain.

This cooperative report was prepared for the guidance of local officials in planning land use and regulating development within the flood plain. The 10-, 50-, 100- and 500-year frequency flood events were selected to represent degrees of major flooding that could occur in the future. The 100-year [1/] and the 500-year [2/] floods are frequencies considered for planning land use and development in the flood plain. Potential flooded areas are defined by flood hazard photomaps that show the approximate areas subject to inundation. Flood profiles show the water surface elevations for the selected events. Typical valley cross sections are presented to indicate ground levels across the width of the valley with the overlying flood depths. The flood profiles and flooded area photomaps are based on conditions at the time of the study.

This report does not imply any federal authority to zone or regulate use of the flood plain; authority to zone and regulate rests with state or local governments. Technical data provided are for the potential future adoption of local land use controls to regulate flood plain development. Since this report indentifies flood problems, it will give guidance for the development, with

1/ A flood which has a 1 percent chance of being equaled or exceeded in any year (also called "base" flood).

2/ A flood which has a 0.2 percent chance of being equaled or exceeded in any year.

environmental considerations, of flood damage reduction techniques such as flood control structures, removal of obstructions and flood proofing for use in an overall Flood Plain Management Program.

The assistance and cooperation of the city of Parshall, Mountrail County Water Resource District, Fort Berthold Soil Conservation District, North Dakota State Water Commission and private citizens in carrying out this study is appreciated.

EAST FORK SHELL CREEK FLOOD PLAIN MANAGEMENT STUDY

TABLE OF CONTENTS

FIGURES

TABLE OF CONTENTS - continued

APPENDIXES

U.S. DEPARTMENT OF AGRICULTURE

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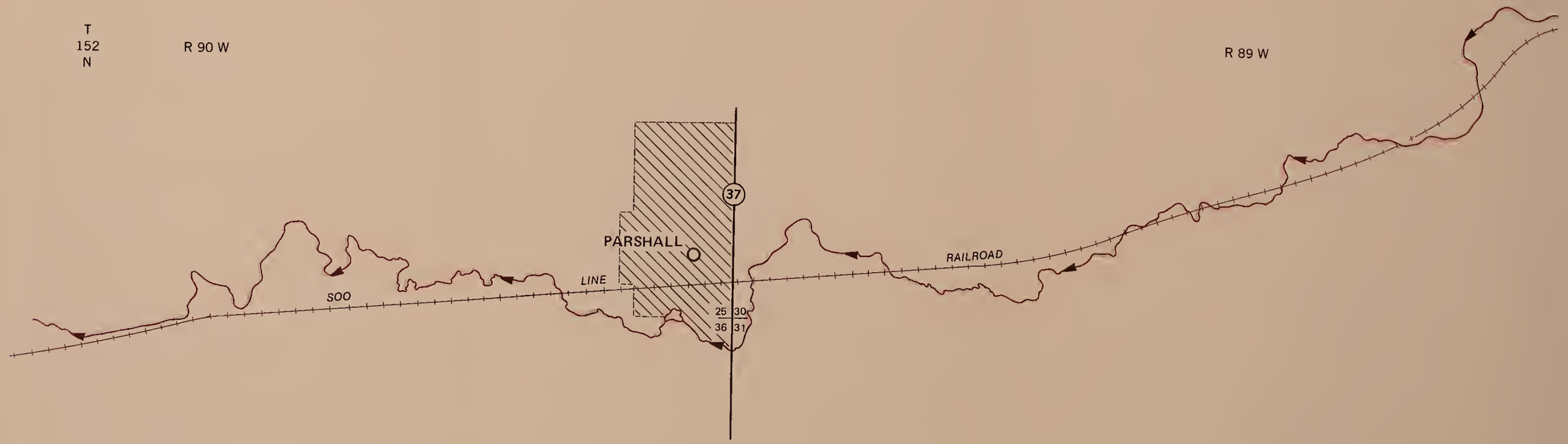

LEGEND

- TOWN
- STREAM CHANNEL
- 37 STATE HIGHWAY
- RAILROAD
- STREAM REACH STUDIED

N

NORTH DAKOTA

VICINITY MAP

EAST FORK SHELL CREEK FLOOD PLAIN MANAGEMENT STUDY

MOUNTRAIL COUNTY,
NORTH DAKOTA

SCALE 0 1 MILE

APPROXIMATE

Figure 1

SOURCE:
USGS 1/250,000 QUADRANGLES
AND INFORMATION FROM SCS FIELD PERSONNEL

NOVEMBER 1983 4-R-38386

USDA-SCS-FORT WORTH, TEXAS 1984

INTRODUCTION

The purpose of this cooperative study is to identify flood hazard areas along the East Fork Shell Creek in Mountrail County, North Dakota, and provide technical data necessary to implement an effective local flood plain management program. Increasing pressure to develop flood plain areas is becoming apparent as competition for land grows. Increasing land values and scarcity of undeveloped areas in which to expand often result in flood plain encroachment. Unregulated development and encroachment frequently result in reduced flood conveyance, thereby increasing flood stages and overall flood losses.

Since the advent of federal laws governing financing within flood plains, many financial institutions are reluctant to lend and federal agencies cannot finance projects in these communities, unless there is assurance that the area is flood free or can be protected.

It is imperative that flood plains in agricultural areas be defined so that the planning and location of valuable properties can be controlled and areas identified where future flood control measures can be applied.

This flood hazard study was requested by the city of Parshall, Mountrail County Water Resource District and the Fort Berthold Soil Conservation District, through the North Dakota State Water Commission, under the 1978 Joint Coordination Agreement with the Soil Conservation Service. Priorities regarding such studies are set by the North Dakota State Water Commission. The study was carried out in accordance with the June 1982 Plan of Study between the city of Parshall, Mountrail County Water Resource District, Fort Berthold Soil Conservation District, North Dakota State Water Commission and the Soil Conservation Service.

The study begins at river mile 4.69 of the East Fork Shell Creek and proceeds upstream along the East Fork Shell Creek to river mile 19.86, approximately 5 miles east of Parshall, North Dakota. River mile 0.0 is the U.S. Government boundary of Lake Sakakawea (North Section Line of Section 1, T. 151 N., R. 91 W.).

The "Extra Territorial Jurisdiction Law", passed by the 1975 North Dakota Legislature, provides communities with zoning authority outside the corporate limits The 1981 North Dakota Legislature amended and re-enacted the law to include each quarter-quarter section within one-half mile of the corporate limits for incorporated cities with a population of 5,000 or less. The extra territorial jurisdiction for the city of Parshall, the only city in the study area, is covered by this study.

Flood plain management studies carried out by the Soil Conservation Service results from recommendations found in A Report by the Task Force on Federal Flood Control Policy, House Document No. 464 (89th Congress, second session), Recommendation 9(c), "Regulation of Land Use."

Authority for this study is provided by Section 6 of Public Law 83-566, authorizing the USDA to cooperate with other federal, state and local agencies in conducting investigations and surveys within watersheds of river and waterways, as a basis for coordinated programs. In carrying out this study, the Soil Conservation Service is responsive to Executive Order No. 11988, dated May 24, 1977, which directs that "all executive agencies responsible for programs which entail land use planning shall take flood hazards into account when evaluating plans and shall encourage land use appropriate to the degree of hazard involved."

Potential users of flood plains should base planning decisions upon the advantages and disadvantages of each location. Potential flood hazards are often unknown and consequently the managers, potential users, and occupants cannot always accurately assess these risks. In order for a local flood plain management program to be effective in the planning, development and use of flood plains, it is necessary for SCS to:

1. Assist the state and local units of government by preparing appropriate technical information and interpretations for use in their flood plain management programs.

2. Provide technical services to managers of flood plain property for present and future land uses.

3. Improve basic technical knowledge about flood hazards in cooperation with other agencies and organizations.

This report contains aerial photomaps, water surface profiles and typical valley and channel cross sections, indicating the extent of flooding which can be expected on the East Fork Shell Creek. The 10-, 50-, 100- and 500-year frequency flood discharges and elevations are included.

The North Dakota State Water Commission or the Soil Conservation Service will, upon request, provide technical assistance to federal, state and local agencies and organizations in the interpretation and use of the information contained in this study.

DESCRIPTION OF STUDY AREA

The study area of the East Fork Shell Creek Flood Plain Management Study is located in the Water Resource Council's Missouri Region and Subregion 10110101.

The temperature range within the study area is large from summer to winter, and on occasion from day to day. In the winter, outbreaks of arctic air brings bitter cold. Most winters have many days with temperatures below zero. The mean temperature for the winter months of December, January and February is 11.6°F. Summers are warm and pleasant. The average temperature for the summer months of June, July and August is 65.9°F. Average annual precipitation is about 15 inches.

The East Fork Shell Creek has its source in the glaciated uplands of a southwestward sloping topographic area known as the Coteau Slope. Numerous streams flow from this area to the Missouri River. The East Fork Shell Creek has its headwaters in the glaciated uplands, about 16 miles northeast of Parshall, North Dakota. The underfit creek meanders across its flood plain in a well defined valley that was formed by glacial melt waters. Through Parshall the valley widens out and has a flatter flood plain than what exists a few miles upstream or downstream. The creek joins Lake Sakakawea about 6 miles west of Parshall, North Dakota.

NATURAL VALUES

The East Fork Shell Creek Flood Plain Management Study Area consists of the flood plains and adjacent uplands. Land use for this study area is made up of commercial, agricultural, farmstead, mined, recreation, residential, transportation services, wildlife and woodland.

Commercial lands include businesses, underground and surface utilities, access streets and alleys in the south and east parts of Parshall.

The agricultural land consists of small grain and row cropland, rangeland, pastureland, hayland (tame and native) and farmstead areas including

windbreaks and associated farmstead structures and facilities. Prime farmland constitutes less than one percent of acreage within the study area. Of the four prime farmland sites within the study area, 75% occurs outside of the flood plain, of which cropland is the dominant land use, with lesser amounts of range, recreation and transportation services land. Of the remaining 25% prime farmland acreage, within the flood plain, range is the dominant land use with crop and recreation land being present in lesser amounts.

Mined land uses include several active and inactive gravel pits scattered within the study area.

Recreation land in the study area occurs as city park facilities, a ball diamond and a gold course all located within or near the city of Parshall.

Residential land uses include permanent dwellings in Parshall.

Transportation services land included in the study area are roads, streets, a highway, a railroad, utility rights-of-way and other transportation facilities.

Wildlife land uses in the study area occur, for the most part, as secondary uses to the primary land uses listed previously. Woody areas are very limited and scattered. They occur mostly along the lower end of the study area especially along the flood plain and steeper slopes. Species observed include cottonwood, willow, green ash, plum, buffaloberry, hawthorn and snowberry.

These woody areas provide den and nesting sites, winter and escape cover and food for the various resident and migratory species of wildlife. Because the areas are so limited, their value to wildlife habitat is high and the need to protect/enhance these areas is very significant.

There are planted windbreaks in the study area that add significantly to the overall habitat of the study area even though these plantings do not exhibit the habitat quality of native trees and shrub species.

Riparian, herbaceous vegetation associated with the East Fork Shell Creek flood plain, tributaries and wetlands has been encroached upon by agricultural operations. These operations have reduced the natural cover produced by riparian vegetation and correspondingly reduced the wildlife habitat value of the study area.

Flood plains and associated wetlands have the potential of producing riparian vegetation which furnish breeding, nesting, feeding and resting areas for waterfowl; breeding and bearing habitat for big and small game, furbearers and other wildlife; spawning and nursery areas for fishes and aquatic invertebrates; and a high yield food source for many resident and migratory species.

Some of the wildlife species apt to be utilizing the study area include amphibians and reptiles such as: tiger salamander, Great Plains toad, leopard frog, painted turtle and garter snake; birds such as: eared grebe, mallard, gadwall, redhead, lesser scaup, ruddy duck, American coot, killdeer, lesser yellowlegs, Swainson's hawk, redtailed hawk, marsh hawk, pheasant, gray partridge, sandhill crane, mourning dove, owls, eastern kingbird, yellow-shafted flicker, horned lark, barn swallow, common crow, brown thrasher, yellow warbler, yellow-rumped warbler, common yellowthroat, house sparrow, western meadowlark, redwinged blackbird, brown-headed cowbird, American goldfinch, savannah sparrow, tree sparrow, chipping sparrow and chestnut collared longspur; mammals such as: masked shrew, eastern cottontail, thirteen-lined ground squirrel, deer mouse, boreal redback vole, muskrat, red fox, raccoon, least weasel, longtailed weasel, mink, striped skunk and white-tailed deer;

and fish such as: northern pike, walleye, yellow perch, white bass, catfish, sturgeon, gar, bullhead, suckers, carp and other minnows.

This stream is not, nor is it proposed to be, listed in the National Wild and Scenic Rivers System. No critical habitat for threatened and endangered species was identified in the study area.

The 1978 Stream Evaluation Map - State of North Dakota classified East Fork Shell Creek below Parshall as Class II (a high priority fishery resource) and the stream segment above Parshall as Class III (a substantial fishery resource). This stream outlets into Lake Sakakawea (Garrison Reservoir) approximately two miles below the lower end of the study area.

FLOOD HISTORY

Most of the flooding occurs in the spring of the year, usually in April. Large floods occur from spring snowmelt runoff due to winter accumulation of snow and frozen soil conditions. There is no historical documentation of large floods occurring from excess rainfall. Figures 3 through 8 show photographs of recent floods. Large floods in recent years occurred in 1969 and 1979.

FLOOD POTENTIAL

Potential flood areas within the East Fork Shell Creek Watershed include primarily agricultural land. A limited number of homes and grain storage facilities are subject to inundation during a 100-year frequency flood event. Flood damages include loss of stored grain, eroded land, sediment deposition, washed out fences, weakened roads and bridges, water-soaked buildings and personal property.

The possibility of a severe flood exists in the northeast portion of Parshall. A small retention dam was constructed to control runoff. This

dam has a drainage area of about 420 acres, storage capacity of approximately 12 acre-feet, and a 24-inch corrugated metal pipe for a pincipal spillway. There is no emergency spillway. The dam is approximately 12 feet high. If this dam fails, severe flooding would occur to a large retirement home and several residences downstream.

Restrictive bridges, culverts, dense vegetation and sharp meanders in the channel all contribute to the severity of flooding within the flood plain.

Floodwaters in the East Fork Shell Creek rise rapidly. Duration of flooding normally ranges from 2 to 6 days for each significant flood event.

A 500-year frequency flood within the study area will inundate approximately 1450 acres and a 100-year flood will inundate about 1310 acres. A total of 15.17 river miles along the East Fork Shell Creek were studied. Major flooding occurs in and around the city of Parshall.

Figures 9 through 16 show potential flood stages at various locations of the study area.

FLOOD PLAIN MANAGEMENT

With flood hazard information, the city and county can minimize future flood losses by planning for the protection, wise use and orderly development of the flood plain area. The overall plans of the community for industrial, commercial and residential areas, streets, utilities, parks and schools must recognize the need to temporarily store (if possible) and convey floodwaters.

A coordinated planning procedure such as this is a vital part of any comprehensive flood plain management program. Effective flood plain management involves public policy and action for the wise use and development of the flood plain. It also includes such measures as collection and dissemination of flood control information, acquisition of flood plain lands,

construction of control structures and enactment of ordinances and statutes regarding flood plain land use and development.

A viable local flood plain management program is comprised of numerous elements, some of which are: structural flood control works to protect existing development; regulations to guide new development; flood insurance to protect existing and new buildings; and individual protection measures such as flood proofing.

Flood Control Measures

Various structural flood control measures to reduce the flooded area include enlarged bridge openings, dikes, floodwater retarding dams, floodways and channel work, or a combination of the above.

Flood Plain Regulations

Flood plain regulations are designed to permit realistic use of flood plain areas without increasing potential damage. Among the various elements used to accomplish this are zoning ordinances, subdivision regulations, building codes, and sanitary and utility regulations. For a guide, see "A Perspective on Flood Plain Regulations for Flood Plain Management", Corps of Engineers' Manual EP 1165-2-3-4.

Flood Insurance

Under the National Flood Insurance Act of 1969 (PL 90-448), the Federal Emergency Management Agency (FEMA), Division of Federal Insurance and Mitigation (DFIM), is authorized to carry out a National Flood Insurance Program (NFIP), which makes flood insurance coverage available to all walled and roofed structures and their contents used for residential, business,

religious and agricultural purposes, buildings occupied by nonprofit organizations and those owned by state or local governments or their agencies.

The unincorporated areas of Mountrail County are not currently participating in the National Flood Insurance Program. If these areas choose to participate, owners and occupiers of all buildings and mobile homes would be eligible to obtain flood insurance coverage. It is recommended that persons within or adjacent to the delineated flood hazard areas acquire and maintain flood insurance on both the structure and contents.

Further inquiries about the flood insurance program should be directed to the North Dakota State Water Commission, the official state coordinating agency for flood insurance.

Other Measures

Land use and other regulatory controls including zoning, subdivision regulation and building codes play an important role in flood plain management. However, in order for these measures to be effective, it is important that the community takes action to implement other programs and measures to supplement these controls. A few possible measures to protect and control developments in flood prone areas are: (1) open space land acquisition programs, (2) urban renewal programs, (3) preferential tax assessment, (4) flood proofing of existing structures and (5) public policy governing the construction of utilities and public facilities such as bridges and streets.

The North Dakota State Water Commission, upon request, will provide assistance in flood proofing techniques, the implementation of a flood warning system and establishment of a local flood data collection program.

Recommendations

Some specific recommendations for alleviating the flood situation along the flood plains of the East Fork Shell Creek and tributaries are:

1. Adoption of local land use and zoning regulations for all flood plain areas.

The basic purpose of flood plain regulations is to control development on the flood plain consistent with nature's needs for conveyance of flood flows.

2. Flood proofing existing or future buildings that otherwise cannot be adequately protected. (See U.S. Army Corps of Engineers "Manual of Flood Proofing Regulations", EP 1165 2 314 and "Elevated Residential Structures Reducing Flood Damage Through Building Design: A Guide Manual", published by the Federal Insurance and Hazard Mitigation Division, HUD).

3. Using as much of the flood hazard areas as possible for parks and other open space uses.

4. Installation of a dike system to protect extensively developed flood plain areas (especially residential, farmsteads and other buildings). A dike on the east side of Parshall with an estimated construction cost of $22,000 appears to be economically feasible. Benefits/cost are 1.83:1 (see figure 2 on Page 12).

5. Increase the areas of bridge and culvert openings to minimize the restriction of large floods.

6. Improve hydraulic characteristics of channels through enlargements, oxbow cutoffs and active maintenance programs consistent with environmental guidelines.

7. Construct upstream floodwater dams, as feasible, to retard flood flows. None appear to be economically feasible under SCS criteria.

8. Construct diversions to divert runoff away from the developed areas of the flood plain within the city of Parshall. The diversion located northeast of Parshall at an estimated construction cost of $130,000 appears to be feasible. Benefits/cost are 1.2:1 (See figure 2 on page 12).

FIGURE 2

EAST FORK SHELL CREEK
COST EFFECTIVE RECOMMENDATIONS
FOR FLOOD CONTROL AT PARSHALL

Figure 3 - 1979 Flood at Mile 12.26
Photo by Bill Kuehn

Figure 4 - 1969 Flood at Mile 11.95
Photo by John Risan

Figure 5 - Flood at Mile 11.95
Photo by Bill Kuehn

Figure 6 - 1969 Flood at Mile 11.93
Photo by John Risan

Figure 7 - 1979 Flood at Mile 11.65
Photo by Bill Kuehn

Figure 8 - 1979 Flood at Mile 10.22
Photo by State Commission

Figure 9 - M11.00 at North ¼ Line of Section 36, T. 152 N., R. 90 W.

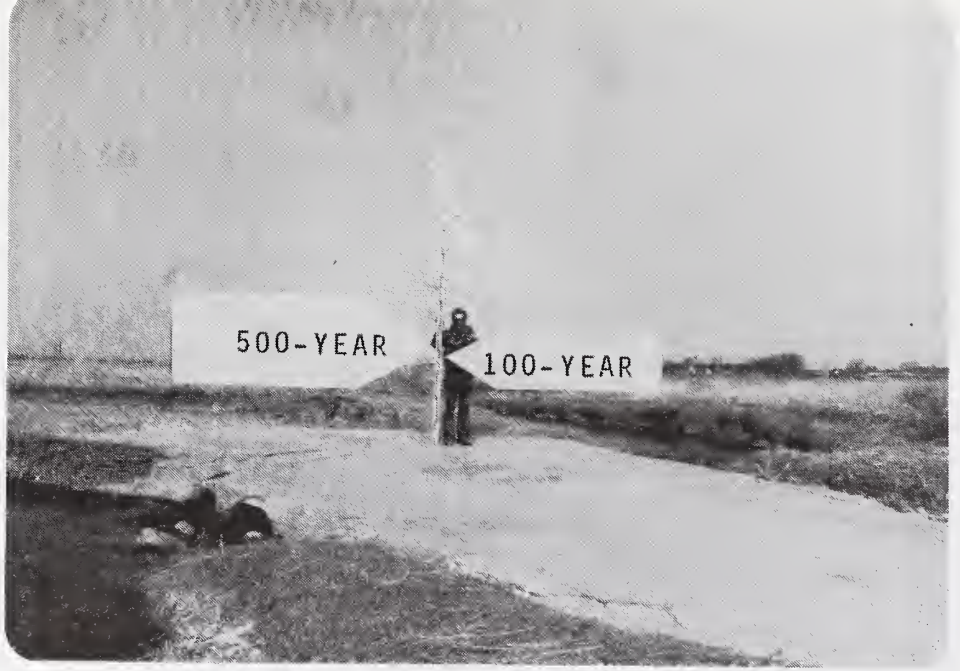

Figure 10 - M11.35 Ball Diamond Road

Figure 11 - M11.39 Parshall Dam

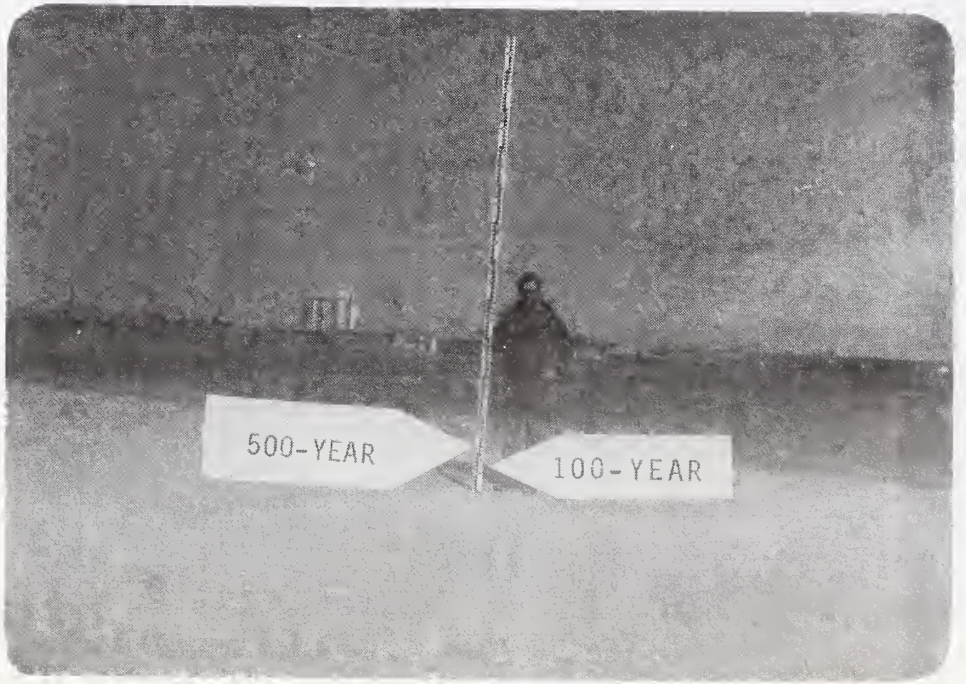

Figure 12 - M11.93 Sections 30 and 31, T. 152 N., R. 89 W.

Figure 13 - M12.28 Hwy 37 North of Railroad

Figure 14 - M13.70 Sections 29 and 30, T. 152 N., R. 89 W.

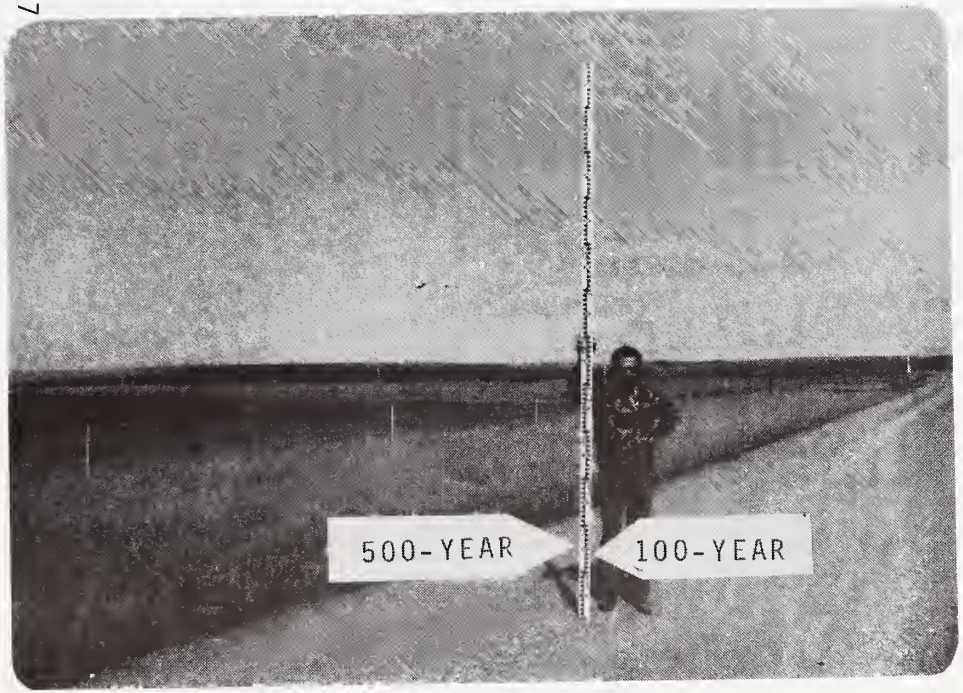

Figure 15 - M15.27 Section 28 and 29, T. 152 N., R. 89 W.

Figure 16 - M18.08 Section 22 and 23, T. 152 N., R. 89 W.

APPENDIX A

SOILS

The soils in the East Fork Shell Creek Watershed are dominately deep, medium textured, well drained with slow permeability and moderate infiltration rates when thoroughly wetted. The soils have a moderate rate of water transmission.

The dominant soils in the watershed are Williams and Zahl [1/]. The Williams soils have a productivity index for spring wheat of 45 to 85. The Zahl soils have a productivity index for spring wheat of 0 to 40. The higher the slopeof land the lower the productivity index. The principal soil limitations of the Williams and Zahl soils for urban uses are slow permeability, slope, or shrink-swell potential. The principal limitation for urban use of the flood plain soils is flooding.

1/ General Soil Map, Mountrail County, published by the Agricultural Experiment Station, North Dakota State University, Fargo, North Dakota, 1963.

Interpretations are given in Table I for a number of uses.

Yields Per Acre

The average yields per acre that can be expected of spring wheat under a high level of management are shown in the table. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; proper planting and seeding rates; use of suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogren, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green-manure crops; and timely harvesting that insures highest profits. Dashes indicate crops not grown or not suited to the soil.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and

generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, woodland or engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass and unit. Only class and subclass are used in this survey. These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have slight limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or require special conservation practices or both.

Class III soils have severe limitations that reduce the choice of plants or require special conservation practices or both.

Class IV soils have very severe limitations that reduce the choice of plants or require very careful management or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils have limitations that essentially preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, e, w, s, or c, to the class numeral, for example, IIe.

The letter e shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; w shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); s shows that the soil is limited mainly because it is shallow, droughty, or stony; and c, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In Class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by w, s or c because the soils in Class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat or recreation.

Prime Farmland

Prime farmland is one of several kinds of important farmlands defined by the U.S. Department of Agriculture. It is of major importance in providing the nation's short and long-range needs for food and fiber. Prime farmland is the land best suited to producing food, feed, forage, fiber and oilseed crops. Prime farmland may now be in pasture, crops, woodland or other land but it is not urban or built up land or water areas.

Soil Uses and Limitations

The soils are rated in the table according to limitations that affect their suitability for playgrounds, picnic areas, dwellings with basements, septic tank absorption fields, sewage lagoons, fill materials for embankments and topsoil. The ratings are based on restrictive soil features such as wetness, slope and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating

a site, is the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity and frequency of flooding is essential.

The degree of soil limitation is expressed as slight, moderate or severe. Slight means that soil properties are generally favorable and that limitations can be overcome or alleviated by planning, design or special maintenance. Severe means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use or by a combination of these measures.

Ratings are made for small dwellings with basements on undisturbed soil. The ratings are based on soil properties, site features and observed performance of the soils. A high water table, flooding, shrink-swell potential and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features and observed performance of the soils. Permeability, a high water

table, depth to bedrock or a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock, or a cemented pan interfere with installation.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use and do not have slopes, stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

The table gives ratings for the natural soil that makes up the lagoon floor. The surface layer and generally 1 to 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Embankments, dikes and levees are raised structures of soil material constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of fill material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater that the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping and erosion, and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, salts or sodium. A high water table affects the amount of usable material.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity and fertility. The ease of

excavating, loading and spreading is affected by rock fragments, slope, water table, soil texture and thickness of suitable material. Reclamation of the borrow area is affected by slope, water table, rock fragments, bedrock and toxic material.

Soils rated good have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer and are not so wet that excavation is difficult.

Soils rated fair are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated poor are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones or soluble salts, have slopes of more than 15 percent or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

TABLE I

MOUNTRAIL COUNTY

EAST FORK SHELL CREEK

SOIL INTERPRETATIONS FOR SELECTED USES

Soil Symbol	Soil Name	Capability Class and Subclass	Prime Farmland	Spring Wheat Bushels/Acre	Dwellings with Basements	Septic Tank Absorption Field	Playgrounds	Picnic Area	Sewage Lagoons	Dikes, Levees Embankments	Topsoil
12	Bowdle Loam, 1 to 3 percent slopes	IIIs	No	19	Slight	Severe-Poor Filter	Moderate-Slope	Slight	Severe-Seepage	Severe-Seepage	Fair-Area Reclaim
20	Combined with Marriet (60)										
23B	Williams Loam, 3 to 6% Slopes	IIe	No	26	Moderate-Shrink-Swell	Severe-Percs Slowly	Moderate-Slope	Slight	Moderate-Seepage Slope	Moderate-Piping	Fair-Large Stones
24C	Max-Zahl Loams, 6 to 9% Slopes	IIIe	No	18							
	Max Part				Moderate-Slope, Shrink-Swell	Severe-Percs Slowly	Severe-Slope	Moderate-Slope	Severe-Slope	Severe-Piping	Fair-Small Stones, Slopes
	Zahl Part				Moderate-Slope, Shrink-Swell	Severe-Percs Slowly	Severe-Slope	Moderate-Slope	Severe-Slope	Moderate-Piping	Fair-Small Stones, Slope
24E	Zahl-Max Loams, 9 to 25% Slopes	VIe	No								
	Zahl Part				Severe-Slope	Severe-Percs Slowly, Slope	Severe-Slope	Severe-Slope	Severe-Slope	Moderate-Piping	Poor-Slope
	Max Part				Severe-Slope	Severe-Percs Slowly, Slope	Severe-Slope	Severe-Slope	Severe-Slope	Severe-Piping	Poor-Slope
24F	Zahl-Max Loams, 25 to 60% Slopes	VIIe	No								
	Zahl Part				Severe-Slope	Severe-Percs Slowly, Slope	Severe-Slope	Severe-Slope	Severe-Slope	Moderate-Piping	Poor-Slope
	Max Part				Severe-Slope	Severe-Percs Slowly, Slope	Severe-Slope	Severe-Slope	Severe-Slope	Severe-Piping	Poor-Slope
32	Bowbells Loam, 1 to 3% Slopes	IIc	Yes	32	Moderate-Shrink-Swell	Severe-Percs Slowly	Moderate-Slope	Slight	Moderate-Seepage Slope	Moderate-Piping	Fair-Small Stones
34	Velva Fine Sandy Loam, 1 to 3% Slopes	IIIe	No	22	Severe-Flooding	Severe-Flooding	Moderate-Flooding	Slight	Severe-Seepage, Flooding	Severe-Piping	Good
41	Divide Loam, Saline	IIIs	No	13	Moderate-Wetness	Severe-Wetness Poor Filter	Severe-Excess Salt	Severe-Excess Salt	Severe-Seepage, Wetness	Severe-Seepage	Poor-Small Stones, Area Reclaim, excess salt
47	Combined with Lehr (47B)										
47B	Lehr Loam, 1 to 6% Slopes	IVe	No	13	Slight	Severe-Poor Filter	Moderate-Slope	Slight	Severe-Seepage	Severe-Seepage	Poor-Small Stones Area Reclaim
54E	Wabek Gravelly Loam, 1 to 25% Slopes	VIs	No		Moderate-Slope	Severe-Poor Filter	Severe-Slope	Moderate-Slope	Severe-Seepage, Slope	Severe-Seepage, Piping	Poor-Small Stones Area Reclaim
58	Noonan Loam, 1 to 3% Slopes	IVs	No	12	Moderate-Shrink-Swell	Severe-Percs Slowly	Severe-Excess Sodium	Severe-Excess Sodium	Moderate-Slope	Severe-Piping, Excess Sodium	Poor-Excess Sodium
60	Harriet Loam	VIs	No		Severe-Flooding Wetness	Severe-Flooding Wetness, Percs Slowly	Severe-Wetness, Percs Slowly Excess Sodium	Severe-Wetness, Excess Sodium, Percs Slowly	Severe-Flooding, Wetness	Severe-Piping, Wetness, Excess Sodium	Poor-Wetness, Excess Sodium
65	Parnell Silty Clay Loam										
	Ponded	VIIw	No		Severe-Ponding Shrink-Swell	Severe-Ponding, Percs Slowly	Severe-Ponding	Severe-Ponding	Severe-Ponding	Severe-Hard to Pack, Ponding	Poor-Wetness
76	Pits, Gravel	VIIs	No								
90	Combined with 41										

FLOOD HAZARD AREA PHOTOMAPS

APPENDIX B

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

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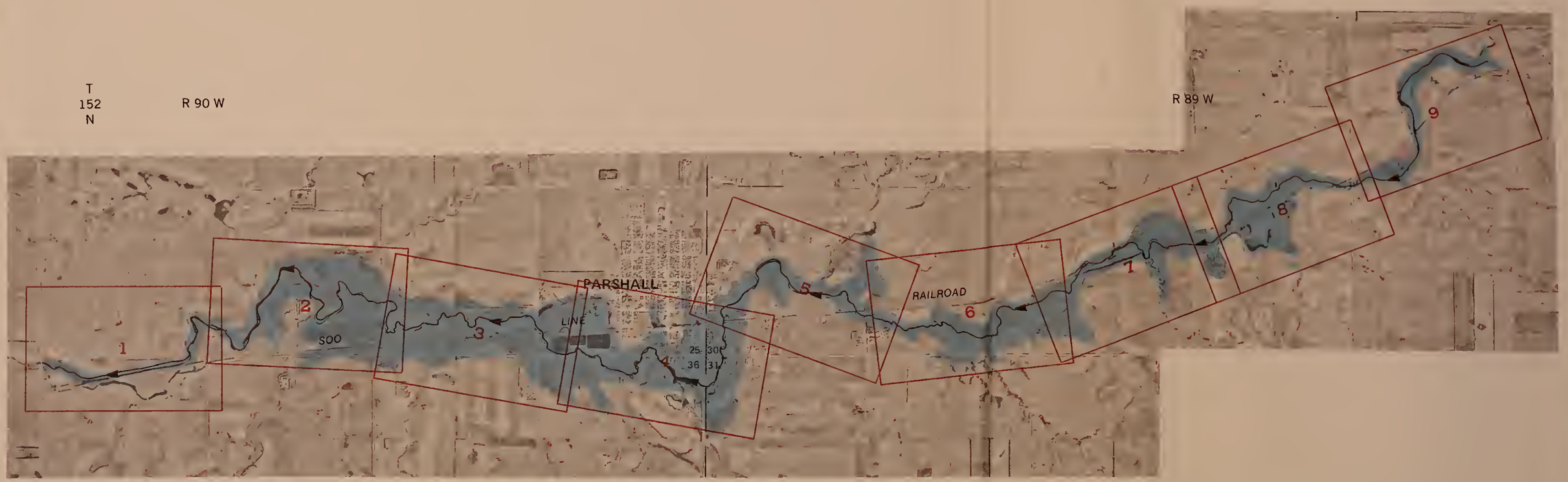
152
N

R 90 W

R 89 W



LEGEND

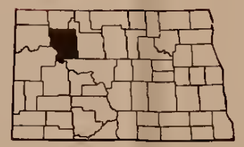
2 SHEET COVERAGE

FLOOD PLAIN AREA (100 AND 500 YEAR FREQUENCY FLOODS)

STREAM CHANNEL

N

NORTH DAKOTA



INDEX TO MAP SHEETS

EAST FORK SHELL CREEK FLOOD PLAIN MANAGEMENT STUDY

MOUNTRAIL COUNTY,
NORTH DAKOTA

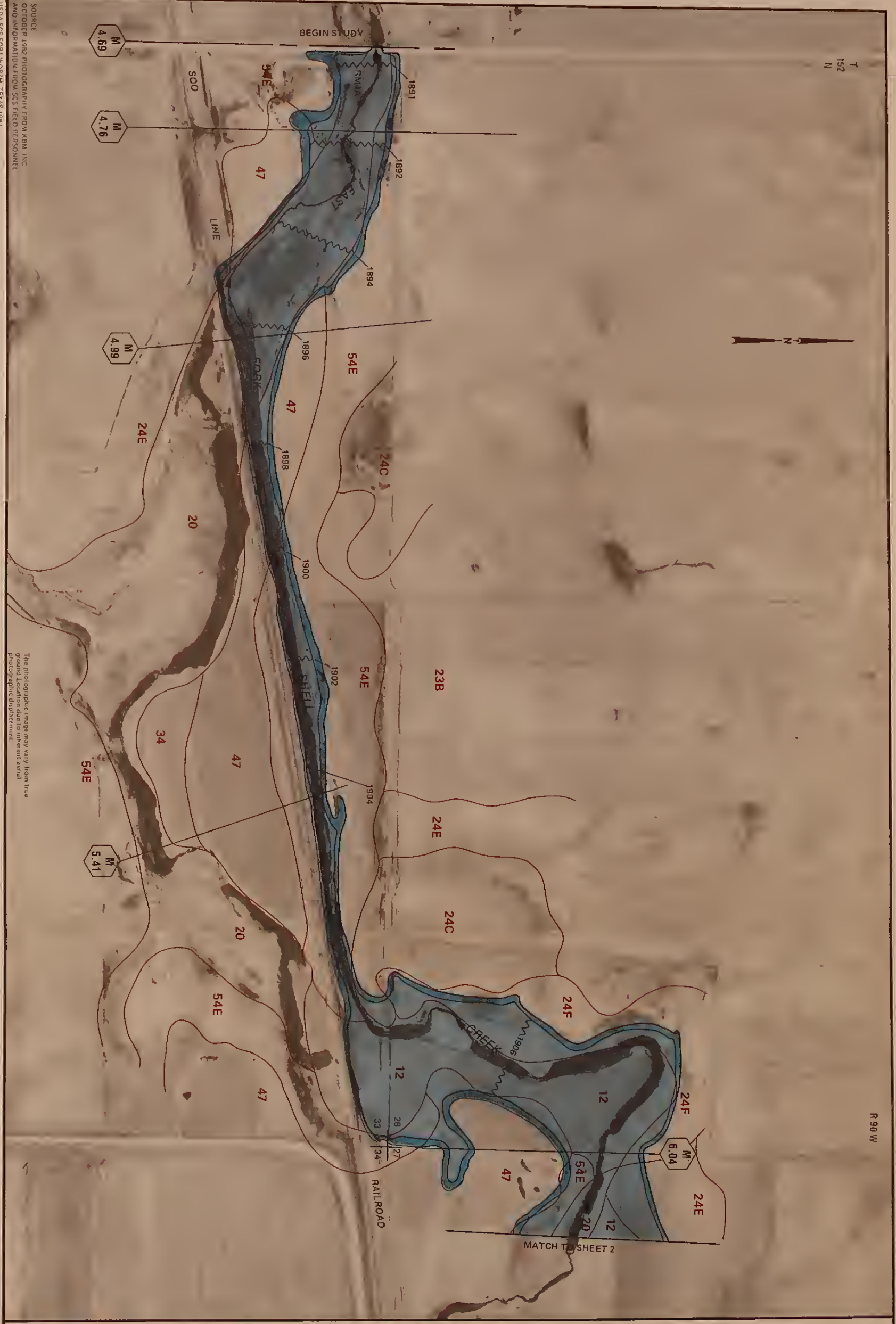
SCALE 0 1 MILE

APPROXIMATE

SOURCE
OCTOBER 1982 PHOTOGRAPHY FROM K&M, INC
AND INFORMATION FROM SCS FIELD PERSONNEL

USDA-SCS-FORT WORTH, TEXAS 1984

NOVEMBER 1983 4-R-38386



SOURCE
OCTOBER 1982 PHOTOGRAPHY FROM KBM INC
AND INFORMATION FROM SCS FIELD PERSONNEL

USDA SCS FORT WORTH, TEXAS 1984

The photographic image may vary from true ground location due to inherent aerial photographic displacement.

LEGEND

- 100 YEAR FREQUENCY FLOOD (1% CHANCE FLOOD)
- 500 YEAR FREQUENCY FLOOD
- STREAM CHANNEL
- M 12.70 — VALLEY SECTION
- 1943 — ESTIMATED 100-YEAR FLOOD ELEV.
- 54E — SOILS AREA & SYMBOLS
- RM 13 X — REFERENCE MARK

SCALE 0 400 800 FEET; 0 100 200 METERS APPROXIMATE

SHEET 1 OF 9

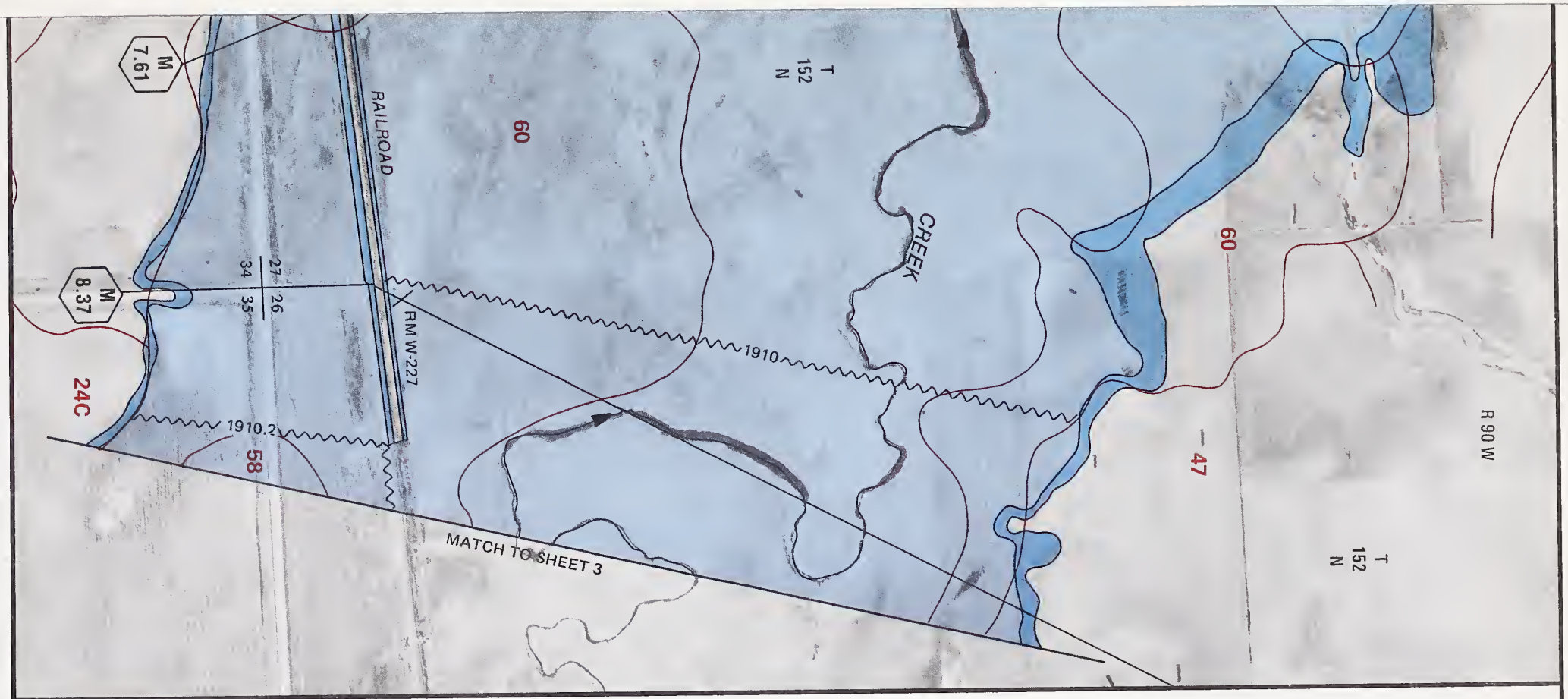
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

FLOOD PLAIN MANAGEMENT STUDY
MOUNTRAIL COUNTY, NORTH DAKOTA

FLOOD HAZARD AREA

EAST FORK SHELL CREEK

NOVEMBER 1983 4-R-3386



LEGEND

100 YEAR FREQUENCY FLOOD (1% CHANCE FLOOD)

500 YEAR FREQUENCY FLOOD

STREAM CHANNEL

M 18.72 VALLEY SECTION

1943 ESTIMATED 100-YEAR FLOOD ELEV.

20 SOILS AREA & SYMBOLS

RM 13 X REFERENCE MARK

SCALE 0 400 800 FEET

0 100 200 METERS APPROXIMATE

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

FLOOD PLAIN MANAGEMENT STUDY

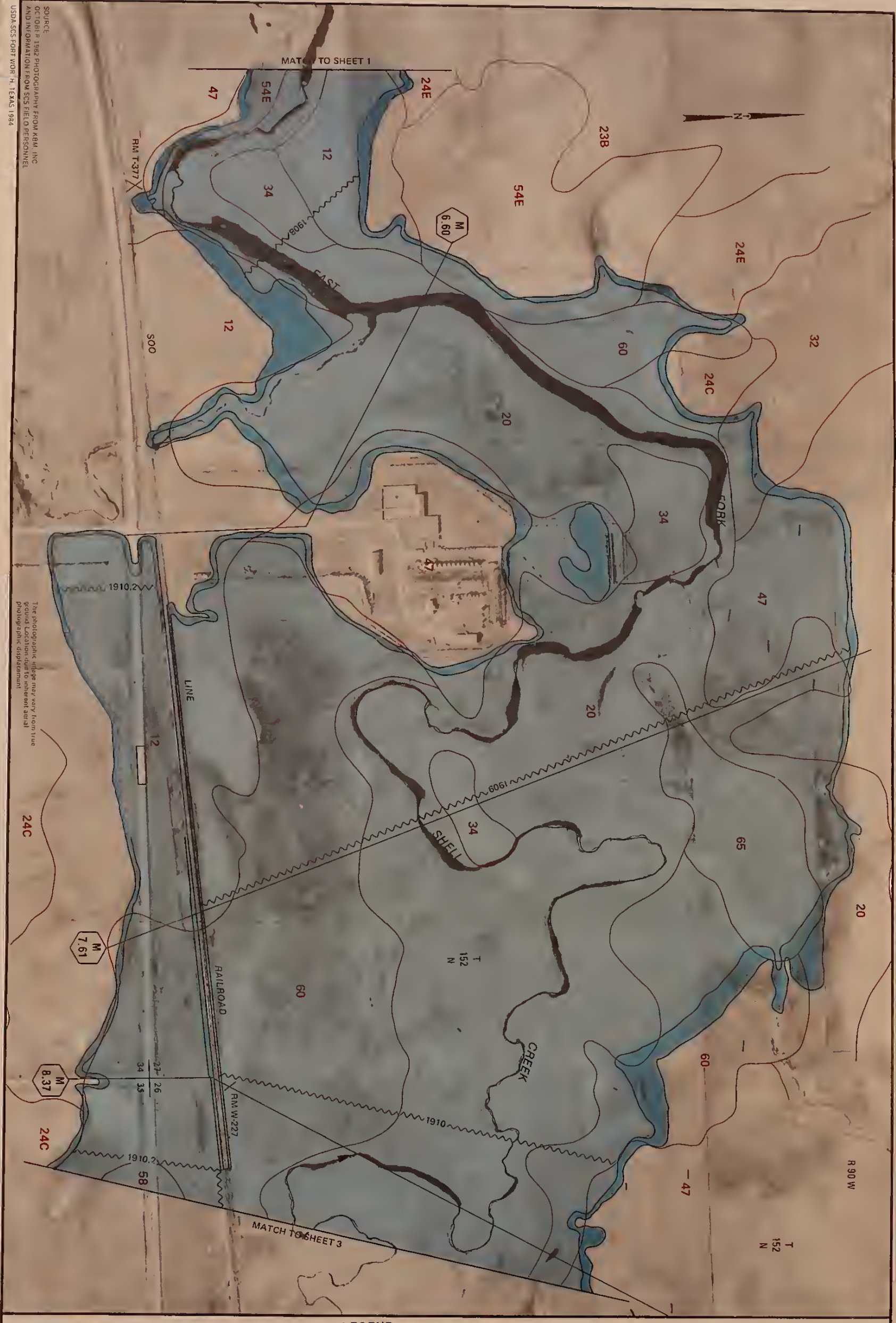
MOUNTRAIL COUNTY, NORTH DAKOTA

FLOOD HAZARD AREA

EAST FORK SHELL CREEK

SHEET 2 OF 9

NOVEMBER 1983 4-R-38386



SOURCE
OCTOBER 1982 PHOTOGRAPHY FROM KBM, INC
AND INFORMATION FROM SCS FIELD PERSONNEL

USDA SCS FORT WORTH, TEXAS 1984

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LEGEND

- 100 YEAR FREQUENCY FLOOD (1% CHANCE FLOOD)
- 500 YEAR FREQUENCY FLOOD
- STREAM CHANNEL
- M 18.72 — VALLEY SECTION
- 1943 — ESTIMATED 100-YEAR FLOOD ELEV.
- 20 — SOILS AREA & SYMBOLS
- RM 13 X — REFERENCE MARK

SCALE 0 400 800 FEET
0 100 200 METERS APPROXIMATE

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

FLOOD PLAIN MANAGEMENT STUDY

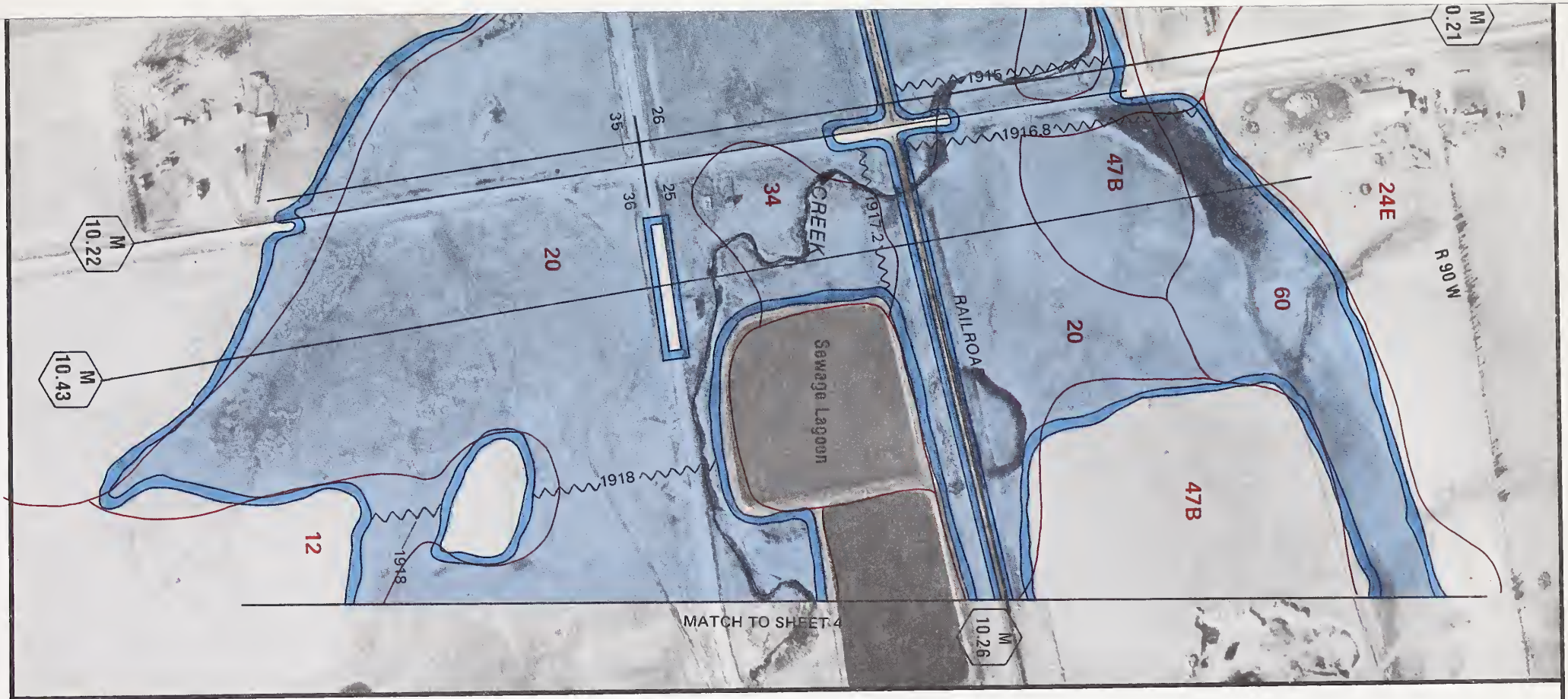
MOUNTRAIL COUNTY, NORTH DAKOTA

FLOOD HAZARD AREA

EAST FORK SHELL CREEK

SHEET 2 OF 9

NOVEMBER 1983 4-R-38386



LEGEND

100 YEAR FREQUENCY FLOOD (1% CHANCE FLOOD)

500 YEAR FREQUENCY FLOOD

STREAM CHANNEL

M 12.70 VALLEY SECTION

1943 ESTIMATED 100-YEAR FLOOD ELEV.

76 SOILS AREA & SYMBOLS

RM 13 X REFERENCE MARK

SCALE 0 400 800 FEET

0 100 200 METERS APPROXIMATE

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

FLOOD PLAIN MANAGEMENT STUDY

MOUNTRAIL COUNTY, NORTH DAKOTA

FLOOD HAZARD AREA

EAST FORK SHELL CREEK

SHEET 3 OF 9

NOVEMBER 1983 4-R-38386

LEGEND

- 100 YEAR FREQUENCY FLOOD (1% CHANCE FLOOD)
- 500 YEAR FREQUENCY FLOOD
- STREAM CHANNEL
- M 12.70 — VALLEY SECTION
- 1943 — ESTIMATED 100-YEAR FLOOD ELEV.
- 76 — SOILS AREA & SYMBOLS
- RM 13 X — REFERENCE MARK

SCALE 0 400 800 FEET; 0 100 200 METERS APPROXIMATE

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

FLOOD PLAIN MANAGEMENT STUDY
MOUNTRAIL COUNTY, NORTH DAKOTA

FLOOD HAZARD AREA

EAST FORK SHELL CREEK

SHEET 3 OF 9

NOVEMBER 1983 4-R-38386

LEGEND

100 YEAR FREQUENCY FLOOD (1% CHANCE FLOOD)

500 YEAR FREQUENCY FLOOD

STREAM CHANNEL

M 11.93 — VALLEY SECTION

1943 — ESTIMATED 100-YEAR FLOOD ELEV.

60 — SOILS AREA & SYMBOLS

CORPORATE LIMIT

RM 13 X — REFERENCE MARK

SCALE 0 400 800 FEET

0 100 200 METERS APPROXIMATE

SHEET 4 OF 9

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

FLOOD PLAIN MANAGEMENT STUDY

MOUNTRAIL COUNTY, NORTH DAKOTA

FLOOD HAZARD AREA

EAST FORK SHELL CREEK

NOVEMBER 1983 4-R-38386

SOURCE
OCTOBER 1982 PHOTOGRAPHY FROM KBM, INC
AND INFORMATION FROM SCS FIELD PERSONNEL

USDA SCS FORT WORTH, TEXAS 1984

The photographic image may vary from true ground Location due to inherent aerial photographic displacement

LEGEND

- 100 YEAR FREQUENCY FLOOD (1% CHANCE FLOOD)
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- STREAM CHANNEL
- M 11.93 — VALLEY SECTION
- 1943 — ESTIMATED 100-YEAR FLOOD ELEV.
- 60 — SOILS AREA & SYMBOLS
- CORPORATE LIMIT
- RM 13 X — REFERENCE MARK

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

SHEET 4 OF 9

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

FLOOD PLAIN MANAGEMENT STUDY
MOUNTRAIL COUNTY, NORTH DAKOTA

FLOOD HAZARD AREA

EAST FORK SHELL CREEK

NOVEMBER 1983 4-R-38386

LEGEND

100 YEAR FREQUENCY FLOOD (1% CHANCE FLOOD)

500 YEAR FREQUENCY FLOOD

STREAM CHANNEL

M 19.86 VALLEY SECTION

1943 ESTIMATED 100-YEAR FLOOD ELEV.

23B SOILS AREA & SYMBOLS

RM 13 X REFERENCE MARK

SCALE 0 400 800 FEET

0 100 200 METERS

APPROXIMATE

SHEET 5 OF 9

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

FLOOD PLAIN MANAGEMENT STUDY

MOUNTRAIL COUNTY, NORTH DAKOTA

FLOOD HAZARD AREA

EAST FORK SHELL CREEK

NOVEMBER 1983 4-R-38386

LEGEND

100 YEAR FREQUENCY FLOOD (1% CHANCE FLOOD)

500 YEAR FREQUENCY FLOOD

STREAM CHANNEL

M 19.86 VALLEY SECTION

1943 ESTIMATED 100-YEAR FLOOD ELEV.

23B SOILS AREA & SYMBOLS

RM 13 X REFERENCE MARK

SCALE 0 400 800 FEET; 0 100 200 METERS APPROXIMATE

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

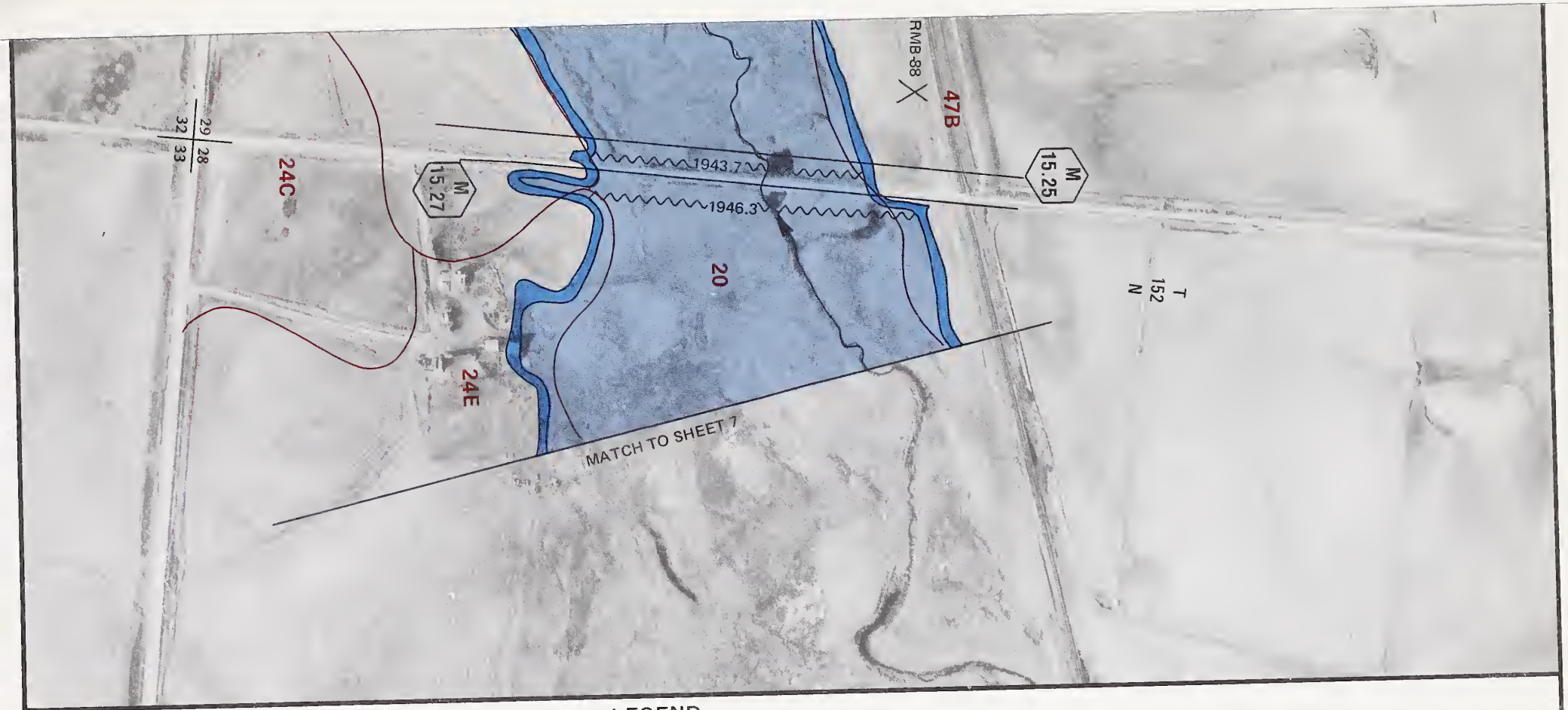
FLOOD PLAIN MANAGEMENT STUDY
MOUNTRAIL COUNTY, NORTH DAKOTA

FLOOD HAZARD AREA

EAST FORK SHELL CREEK

SHEET 5 OF 9

NOVEMBER 1983 4-R-38386



LEGEND

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- 500 YEAR FREQUENCY FLOOD
- STREAM CHANNEL
- M 18.08 — VALLEY SECTION
- 1943 — ESTIMATED 100-YEAR FLOOD ELEV.
- 23B — SOILS AREA & SYMBOLS
- RM 13 X — REFERENCE MARK

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

SHEET 6 OF 9

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

FLOOD PLAIN MANAGEMENT STUDY

MOUNTRAIL COUNTY, NORTH DAKOTA

FLOOD HAZARD AREA

EAST FORK SHELL CREEK

NOVEMBER 1983 4-R-38386

LEGEND

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- 500 YEAR FREQUENCY FLOOD
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SCALE 0 400 800 FEET; 0 100 200 METERS APPROXIMATE

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

FLOOD PLAIN MANAGEMENT STUDY

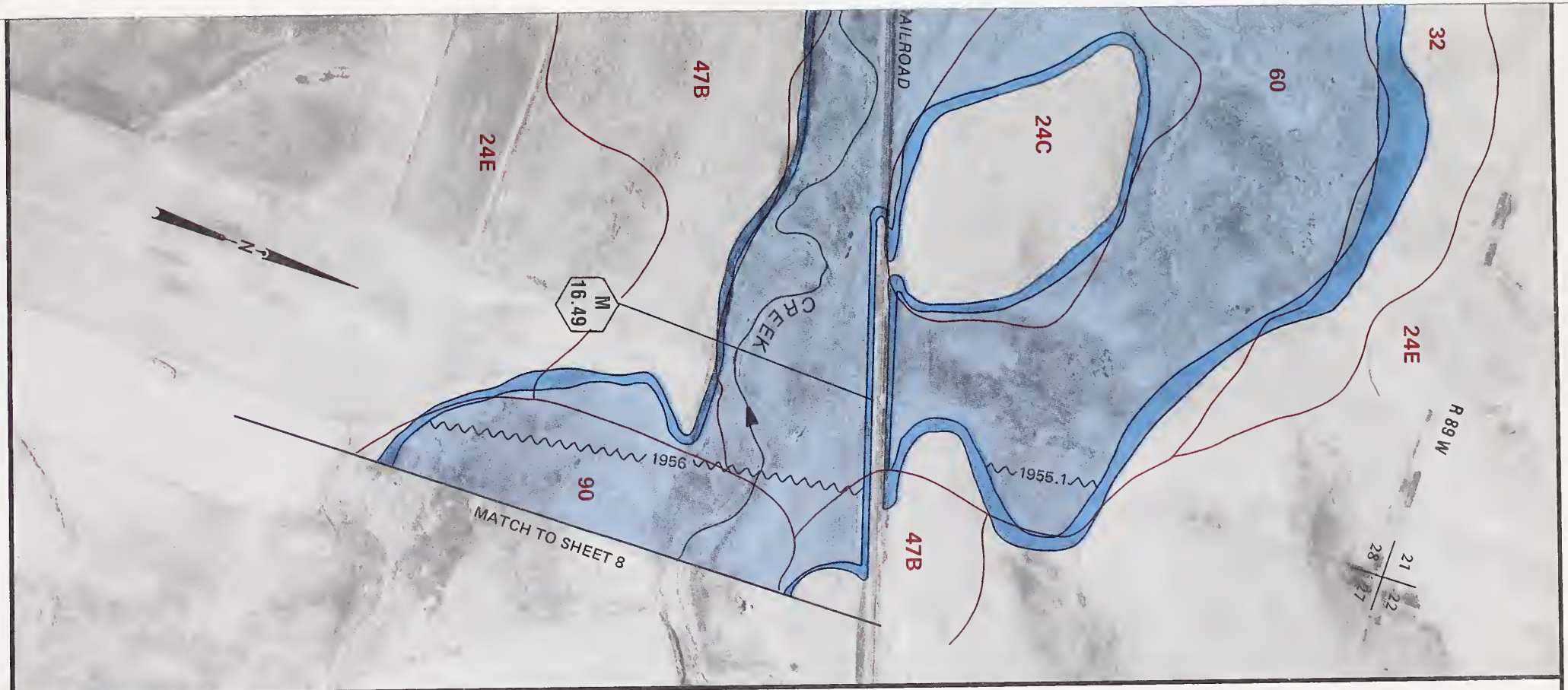
MOUNTRAIL COUNTY, NORTH DAKOTA

FLOOD HAZARD AREA

EAST FORK SHELL CREEK

SHEET 6 OF 9

NOVEMBER 1983 4-R-38386



LEGEND

100 YEAR FREQUENCY FLOOD (1% CHANCE FLOOD)

500 YEAR FREQUENCY FLOOD

STREAM CHANNEL

M 10.43 VALLEY SECTION

1943 ESTIMATED 100-YEAR FLOOD ELEV.

60 SOILS AREA & SYMBOLS

RM 13 X REFERENCE MARK

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

FLOOD PLAIN MANAGEMENT STUDY

MOUNTRAIL COUNTY, NORTH DAKOTA

FLOOD HAZARD AREA

EAST FORK SHELL CREEK

SHEET 7 OF 9

NOVEMBER 1983 4-R-38386

SOURCE
OCTOBER 1982 PHOTOGRAPHY FROM K-BAR, INC.
AND INFORMATION FROM SCS FIELD PERSONNEL

USDA SCS-FORT WORTH, TEXAS 1984

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LEGEND

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- 500 YEAR FREQUENCY FLOOD
- STREAM CHANNEL
- M 10.43 — VALLEY SECTION
- 1943 — ESTIMATED 100-YEAR FLOOD ELEV.
- 60 — SOILS AREA & SYMBOLS
- RM 13 X — REFERENCE MARK

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

FLOOD PLAIN MANAGEMENT STUDY

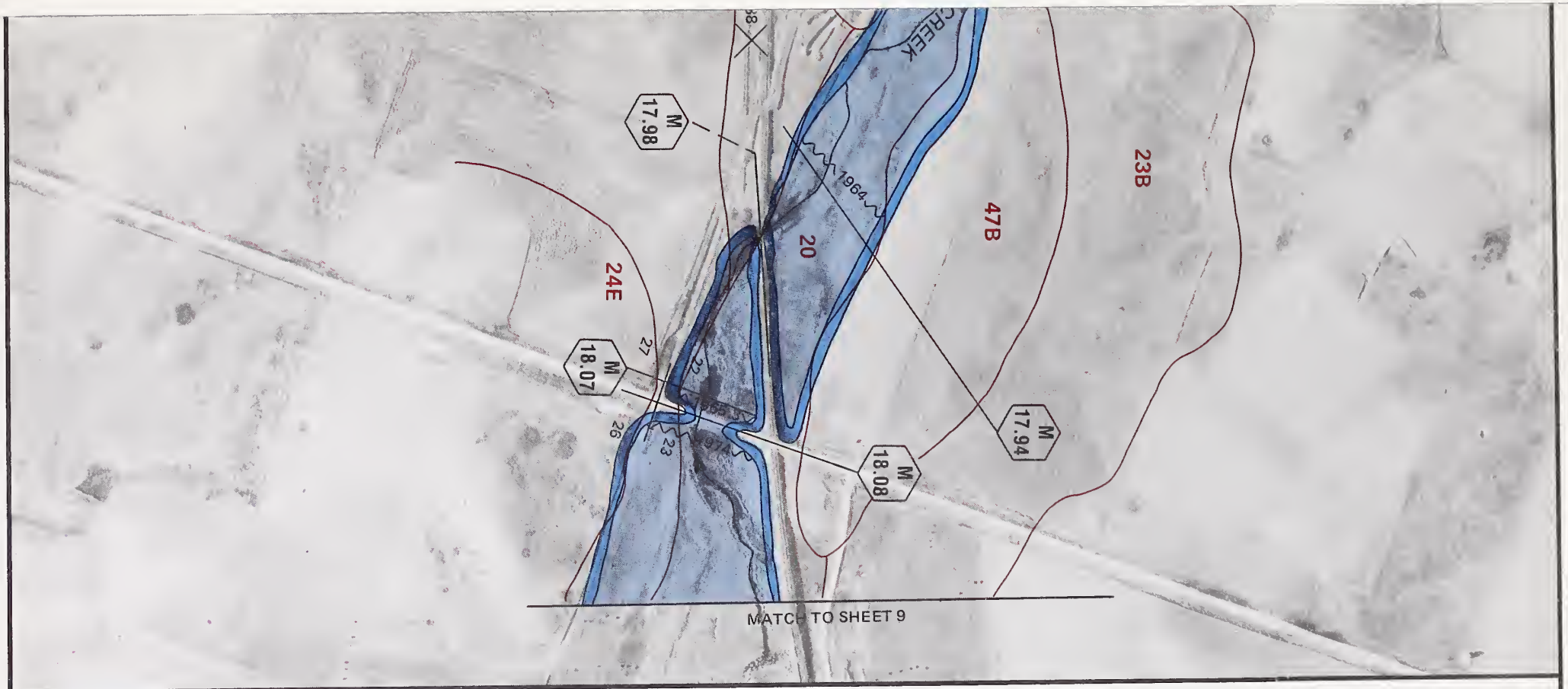
MOUNTRAIL COUNTY, NORTH DAKOTA

FLOOD HAZARD AREA

EAST FORK SHELL CREEK

SHEET 7 OF 9

NOVEMBER 1983 4-R-38386



LEGEND

100 YEAR FREQUENCY FLOOD (1% CHANCE FLOOD)

500 YEAR FREQUENCY FLOOD

STREAM CHANNEL

M 10.43 — VALLEY SECTION

1943 — ESTIMATED 100-YEAR FLOOD ELEV.

47B — SOILS AREA & SYMBOLS

RM 13 X — REFERENCE MARK

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

SHEET 8 OF 9

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

FLOOD PLAIN MANAGEMENT STUDY
MOUNTRAIL COUNTY, NORTH DAKOTA

FLOOD HAZARD AREA

EAST FORK SHELL CREEK

NOVEMBER 1983 4-R-38386

LEGEND

- 100 YEAR FREQUENCY FLDDD (1% CHANCE FLODD)
- 500 YEAR FREQUENCY FLODD
- STREAM CHANNEL
- M 10.43 — VALLEY SECTION
- 1943 — ESTIMATED 100-YEAR FLOOD ELEV.
- 47B — SOILS AREA & SYMBOLS
- RM 13 X — REFERENCE MARK

SCALE 0 400 800 FEET; 0 100 200 METERS APPROXIMATE

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

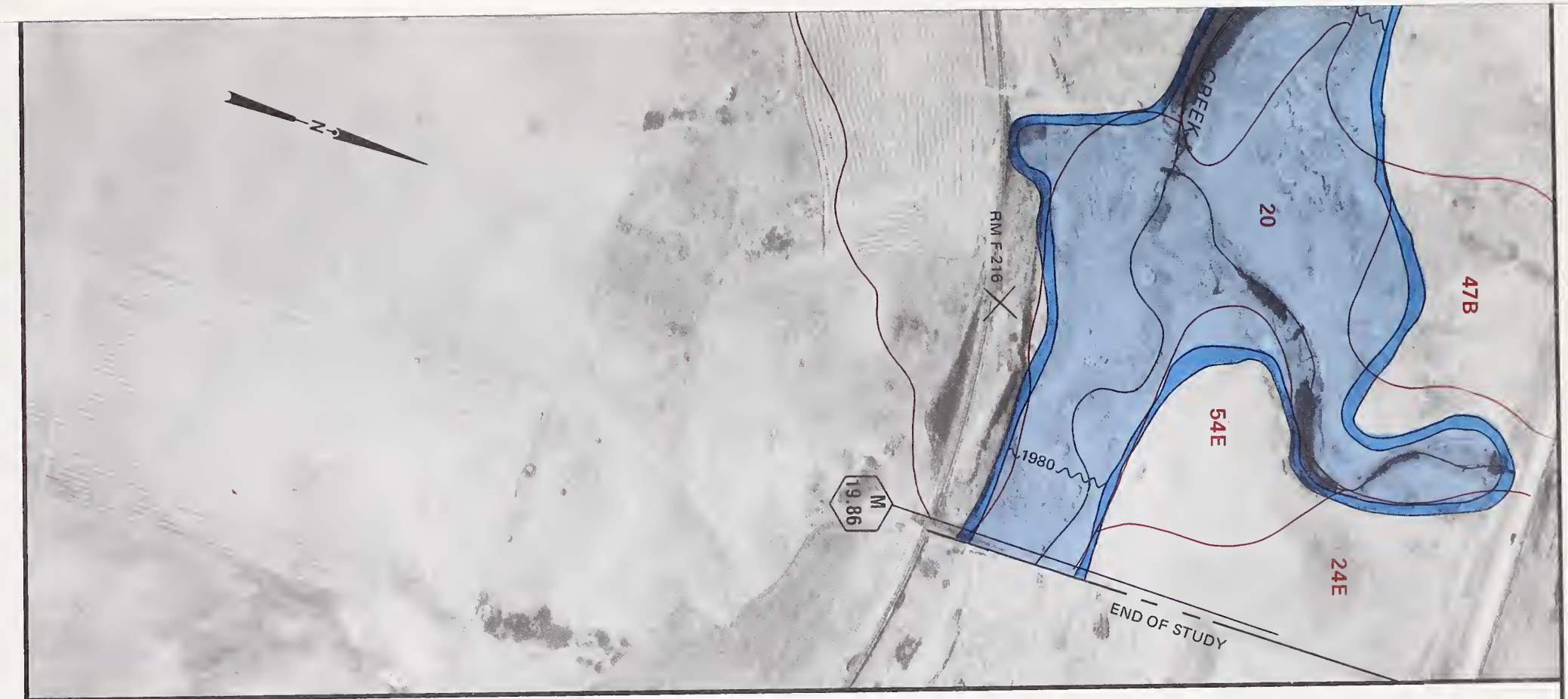
FLOOD PLAIN MANAGEMENT STUDY
MOUNTRAIL COUNTY, NORTH DAKOTA

FLOOD HAZARD AREA

EAST FORK SHELL CREEK

SHEET 8 OF 9

NOVEMBER 1983 4-R-33386



LEGEND

100 YEAR FREQUENCY FLOOD (1% CHANCE FLOOD)

500 YEAR FREQUENCY FLOOD

STREAM CHANNEL

M 13.68 — VALLEY SECTION

1943 — ESTIMATED 100-YEAR FLOOD ELEV.

12 — SOILS AREA & SYMBOLS

RM 13 X — REFERENCE MARK

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

FLOOD PLAIN MANAGEMENT STUDY

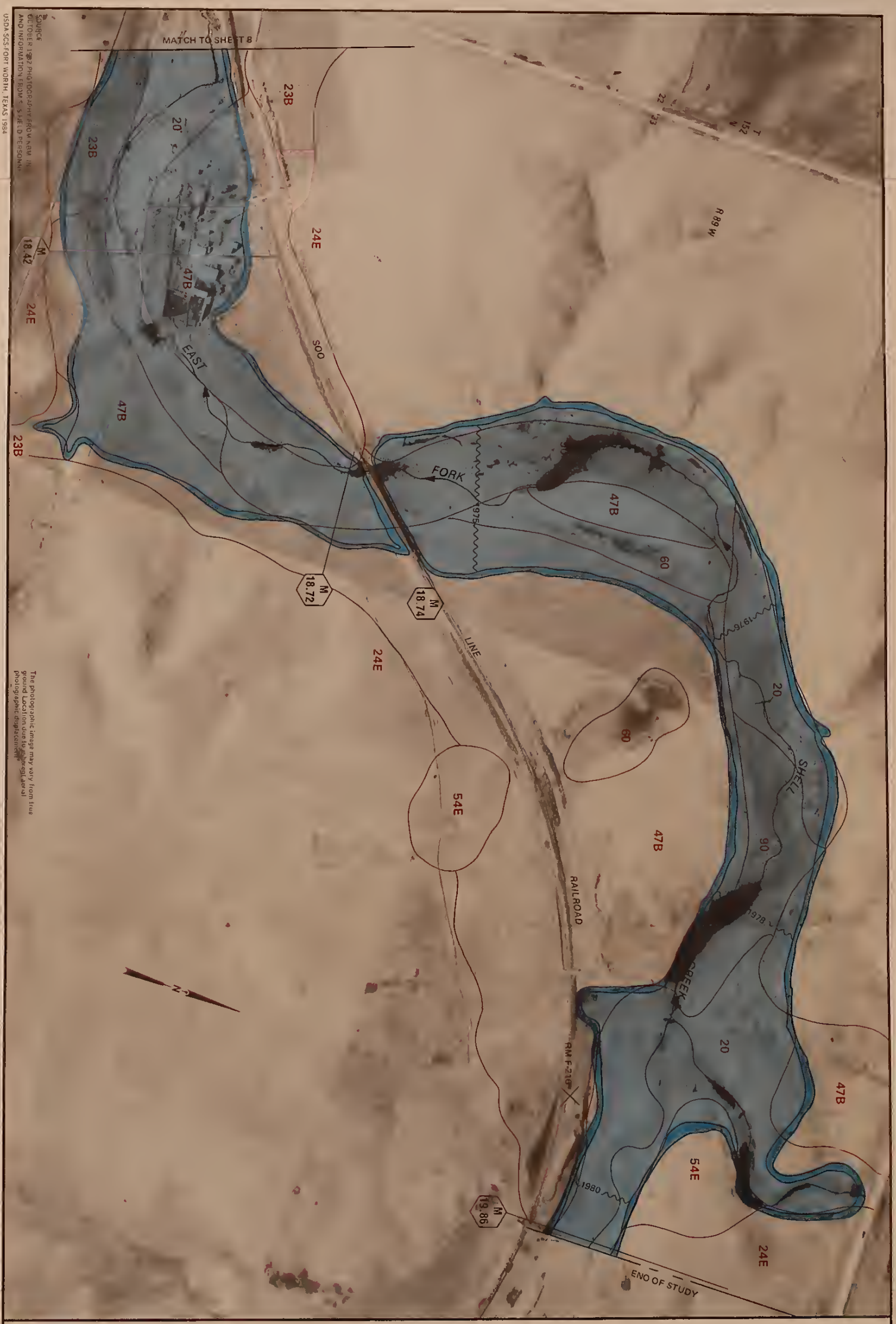
MOUNTRAIL COUNTY, NORTH DAKOTA

FLOOD HAZARD AREA

EAST FORK SHELL CREEK

SHEET 9 OF 9

NOVEMBER 1983 4-R-38386



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- 500 YEAR FREQUENCY FLOOD
- STREAM CHANNEL
- M 13.68 — VALLEY SECTION
- 1943 — ESTIMATED 100-YEAR FLOOD ELEV.
- 12 — SOILS AREA & SYMBOLS
- RM 13 X — REFERENCE MARK

SCALE 0 400 800 FEET; 0 100 200 METERS APPROXIMATE

SHEET 9 OF 9

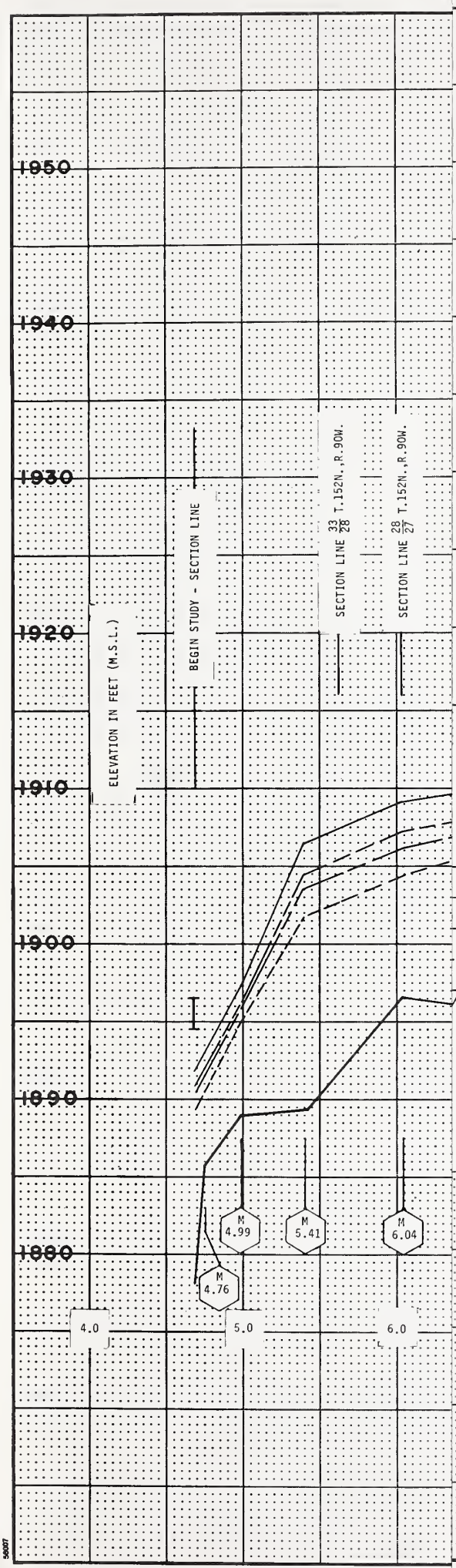
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

FLOOD PLAIN MANAGEMENT STUDY
MOUNTRAIL COUNTY, NORTH DAKOTA

FLOOD HAZARD AREA

EAST FORK SHELL CREEK

NOVEMBER 1983 4-R-38386



LEGEND

500-YEAR FLOOD

100-YEAR FLOOD

50-YEAR FLOOD

10-YEAR FLOOD

STREAM BED CROSS SECTION LOCATION

M 12.12 (RIVER MILE)

DECK BRIDGE LOW BEAM

APPENDIX C

EAST FORK SHELL CREEK PROFILE

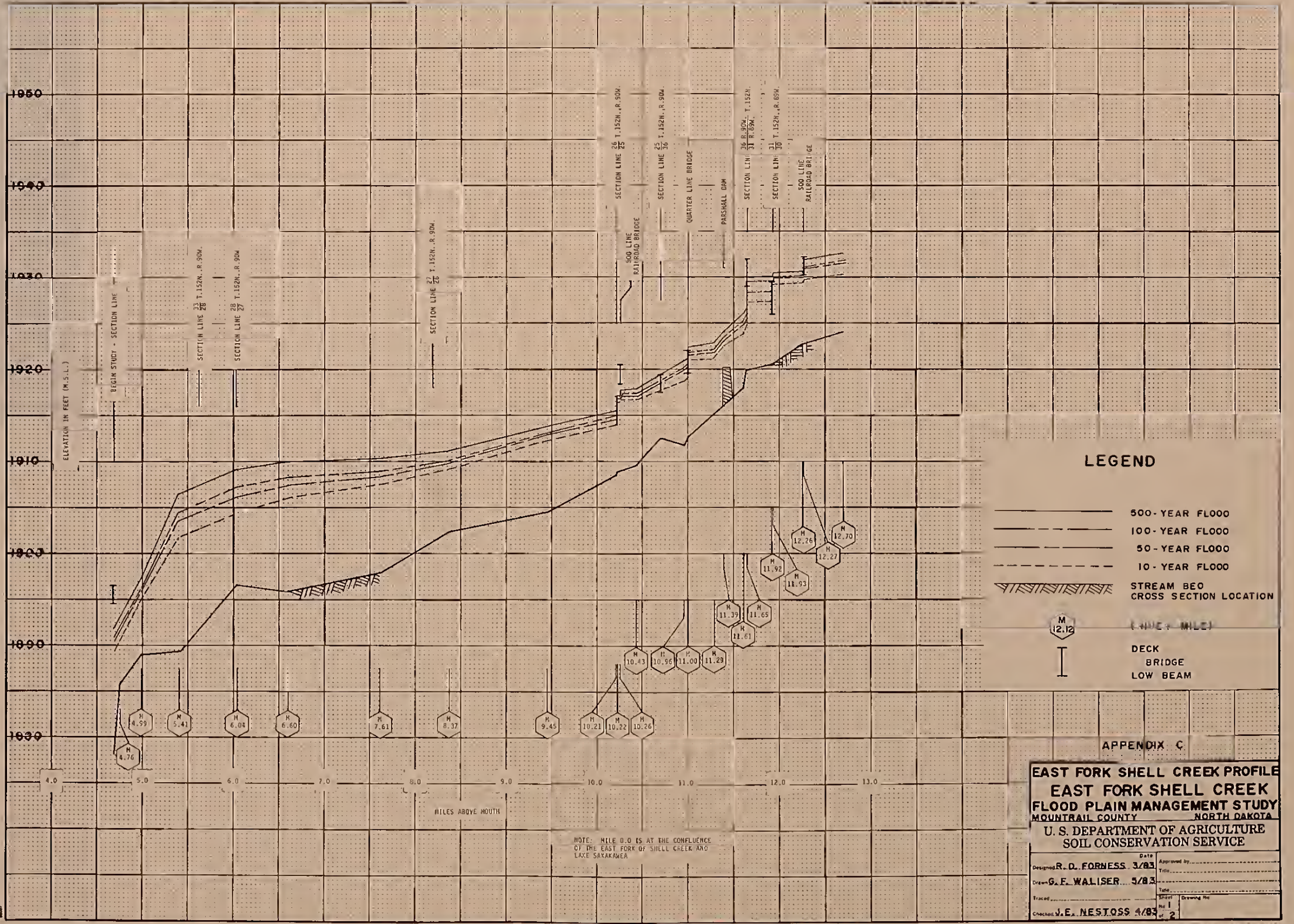
EAST FORK SHELL CREEK FLOOD PLAIN MANAGEMENT STUDY

MOUNTRAIL COUNTY NORTH DAKOTA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

	Date	
Designed R. D. FORNESS	3/83	Approved by
Drawn G. F. WALISER	5/83	Title
Traced		Title
Checked J. E. NESTOSS	4/83	Sheet No 1 of 2 — Drawing No.

56007



APPENDIX C

EAST FORK SHELL CREEK PROFILE

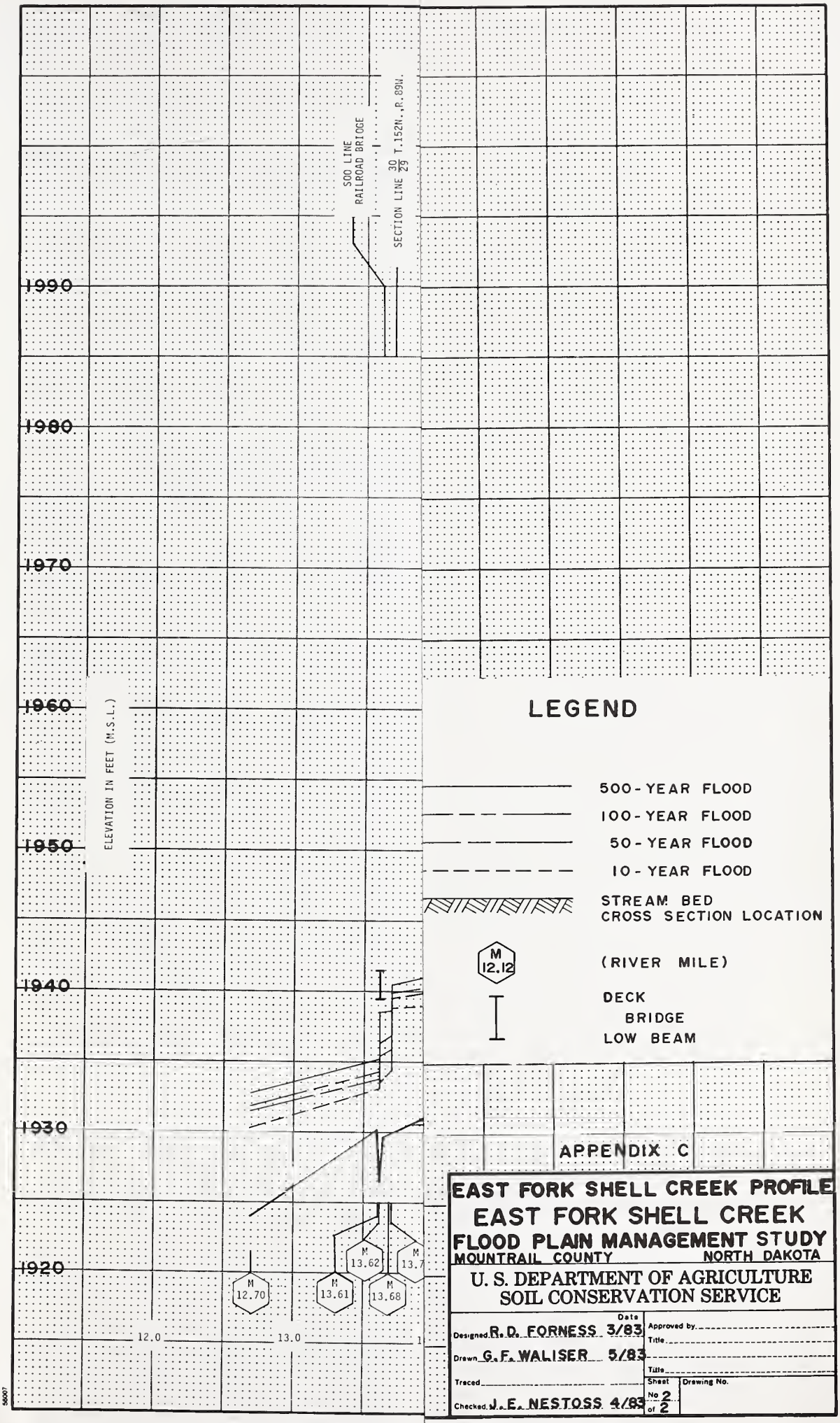
EAST FORK SHELL CREEK
FLOOD PLAIN MANAGEMENT STUDY

MOUNTRAIL COUNTY NORTH DAKOTA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

	Date	
Designed R. D. FORNESS	3/83	Approved by
Drawn G. F. WALISER	5/83	Title
Traced		Date
Checked J. E. NESTOSS	4/83	Sheet No 1 of 2 — Drawing No

FORM SCS - 315 (NOV. 1966)



LEGEND

- 500-YEAR FLOOD
- 100-YEAR FLOOD
- 50-YEAR FLOOD
- 10-YEAR FLOOD
- STREAM BED CROSS SECTION LOCATION
- M 12.12 (RIVER MILE)
- DECK BRIDGE LOW BEAM

APPENDIX C

EAST FORK SHELL CREEK PROFILE

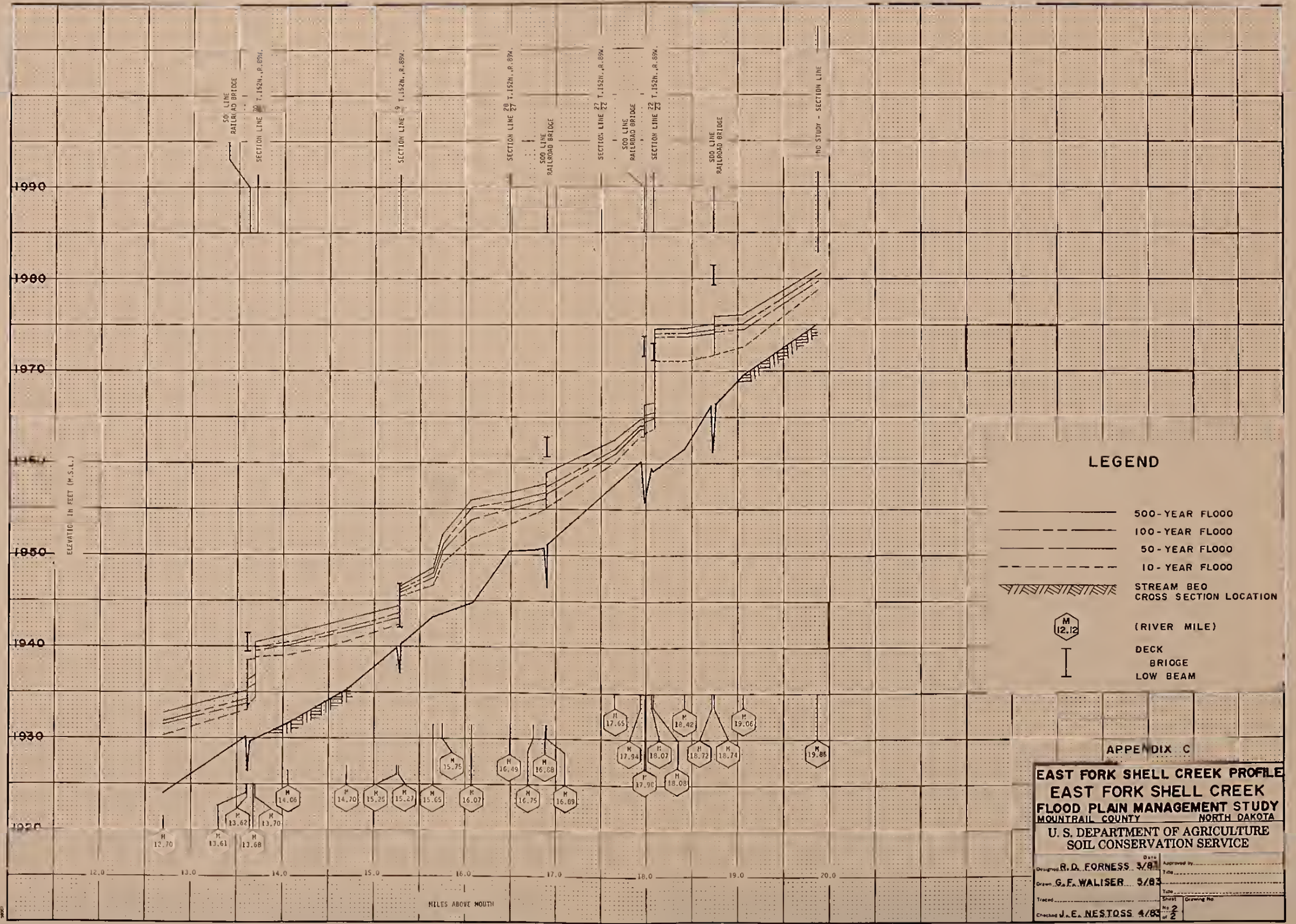
EAST FORK SHELL CREEK
FLOOD PLAIN MANAGEMENT STUDY

MOUNTRAIL COUNTY NORTH DAKOTA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

	Date		
Designed R. D. FORNESS	3/83	Approved by	
Drawn G. F. WALISER	5/83	Title	
Traced		Title	
Checked J. E. NESTOSS	4/83	Sheet No 2 of 2	Drawing No.

58007



LEGEND

- 500-YEAR FLOOD
- 100-YEAR FLOOD
- 50-YEAR FLOOD
- 10-YEAR FLOOD
- STREAM BED CROSS SECTION LOCATION
- M 12.12 (RIVER MILE)
- DECK BRIDGE LOW BEAM

APPENDIX C

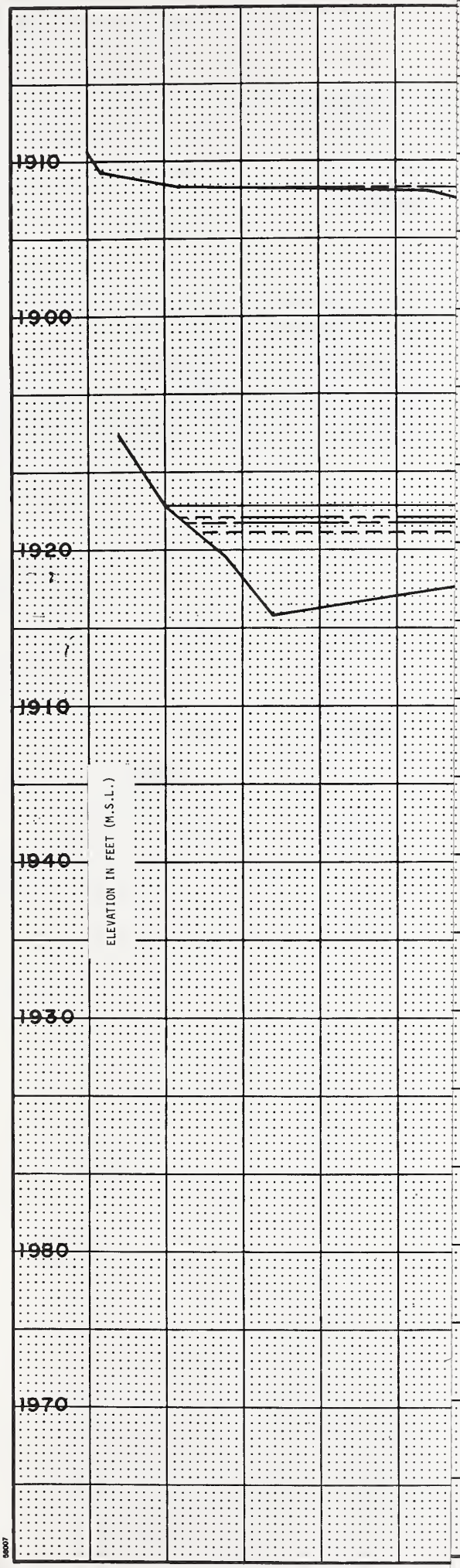
EAST FORK SHELL CREEK PROFILE

EAST FORK SHELL CREEK FLOOD PLAIN MANAGEMENT STUDY

MOUNTRAIL COUNTY NORTH DAKOTA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date		
Designed	R.D. FORNESS	3/83	Approved by	
Drawn	G.F. WALISER	5/83	Title	
Traced			Title	
Checked	J.E. NESTOSS	4/83	Sheet No. 2 of 2	Drawing No.



LEGEND

500 YEAR FLOOD
100 YEAR FLOOD
50 YEAR FLOOD
10 YEAR FLOOD
GROUND LINE

SCALE: 100 FEET

APPENDIX D

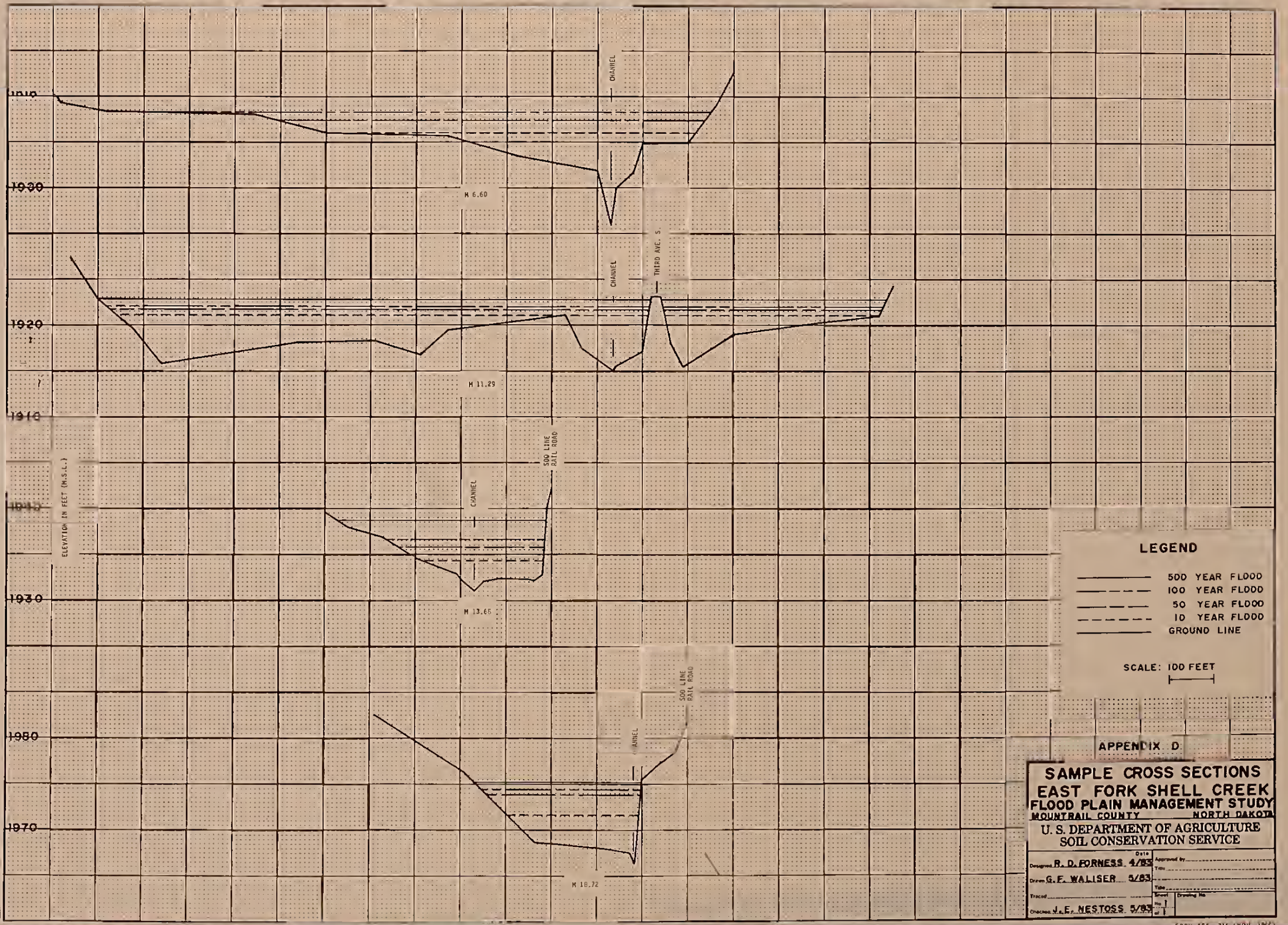
SAMPLE CROSS SECTIONS
EAST FORK SHELL CREEK
FLOOD PLAIN MANAGEMENT STUDY
MOUNTRAIL COUNTY NORTH DAKOTA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Data		
Designed R. D. FORNESS 4/83	Approved by	
Drawn G. F. WALISER 5/83	Title	
Traced	Title	
Checked J. E. NESTOSS 5/83	Sheet No 1 of 1	Drawing No.

98007

FORM SCS - 315 (NOV. 1966)



APPENDIX D

SAMPLE CROSS SECTIONS
EAST FORK SHELL CREEK
FLOOD PLAIN MANAGEMENT STUDY

MOUNTRAIL COUNTY NORTH DAKOTA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

	Date	
Designed R. D. FORNESS	4/63	Approved by
Drawn G. F. WALISER	5/63	Title
Traced		Title
Checked J. E. NESTOSS	5/63	Sheet No. of / Drawing No.

FORM SCS - 315 (NOV. 1966)

DISCHARGE-FREQUENCY DATA

EAST FORK SHELL CREEK

MOUNTRAIL COUNTY

APPENDIX E

EAST FORK SHELL CREEK					
BETWEEN RIVER MILES	DRAINAGE AREA (SQUARE MILES)	500-YEAR FREQ. FLOOD Q (CFS)	100-YEAR FREQ. FLOOD Q (CFS)	50-YEAR FREQ. FLOOD Q (CFS)	10-YEAR FREQ. FLOOD Q (CFS)
4.69					
	161	6,930	4,760	3,810	2,435
10.43					
	140	6,675	4,510	3,550	1,980
11.61					
	123	5,300	3,590	2,830	1,550
12.70					
	104	3,740	2,540	2,000	1,050
16.49					
	94	3,100	2,095	1,640	860
19.86					

WATER SURFACE ELEVATION - FREQUENCY DATA

EAST FORK SHELL CREEK

MOUNTRAIL COUNTY

APPENDIX F

EAST FORK SHELL CREEK EXISTING CONDITION				
RIVER MILE	500-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	100-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	50-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	10-YEAR FREQ. FLOOD ELEVATION (M.S.L.)
4.76 1/	1892.9	1891.8	1891.3	1890.3
4.99	1897.2	1896.1	1895.6	1894.8
5.41	1906.4	1904.5	1903.5	1901.7
6.04	1909.2	1907.3	1906.2	1904.3
6.60	1910.0	1908.3	1907.4	1906.0
7.61	1910.3	1909.0	1908.4	1907.5
8.37	1911.2	1910.2	1909.8	1909.2
9.45	1913.8	1913.2	1913.0	1912.4
10.21	1915.6	1915.0	1914.6	1914.0
10.22	1917.1	1916.8	1916.7	1916.4
10.26	1917.7	1917.2	1917.0	1916.6
10.43	1917.8	1917.3	1917.1	1916.7
10.96	1920.9	1920.2	1919.9	1918.7
11.00	1922.4	1921.9	1921.6	1921.0
11.29	1922.8	1922.2	1921.8	1921.2
11.39	1924.1	1923.5	1923.1	1922.5
11.61	1926.1	1925.2	1924.8	1923.9
11.65	1930.0	1929.4	1928.3	1927.3
11.92	1930.1	1929.5	1928.4	1927.3

1/ River mile 0.00 is at the mouth of the East Fork Shell Creek (Lake Sakakawea).

EAST FORK SHELL CREEK EXISTING CONDITION				
RIVER MILE	500-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	100-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	50-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	10-YEAR FREQ. FLOOD ELEVATION (M.S.L.)
11.93	1930.5	1930.1	1929.8	1929.3
12.26	1930.6	1930.1	1929.9	1929.4
12.27	1932.0	1931.2	1931.0	1929.8
12.70	1932.7	1931.9	1931.5	1930.4
13.61	1935.2	1934.3	1933.9	1933.1
13.62	1938.6	1936.5	1935.5	1933.7
13.68	1938.7	1936.7	1935.8	1934.3
13.70	1940.5	1939.9	1939.6	1938.9
14.06	1941.3	1940.5	1940.1	1939.1
14.70	1943.0	1942.1	1941.7	1940.6
15.25	1944.4	1943.7	1943.2	1942.4
15.27	1946.6	1946.3	1946.0	1945.6
15.65	1948.7	1948.1	1947.6	1946.8
15.75	1952.2	1951.1	1950.5	1949.2
16.07	1956.0	1955.1	1953.9	1951.9
16.49	1956.8	1955.8	1955.0	1953.4
16.75	1957.5	1956.5	1955.8	1954.5
16.88	1957.8	1956.8	1956.2	1955.0
16.89	1958.9	1957.5	1956.7	1955.3
17.65	1962.6	1961.5	1961.0	1960.0
17.94	1964.8	1964.1	1963.7	1962.9
17.98	1966.3	1965.0	1964.4	1963.2
18.07	1966.5	1965.3	1964.7	1963.5
18.08	1974.6	1974.0	1973.6	1971.0

EAST FORK SHELL CREEK EXISTING CONDITION				
RIVER MILE	500-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	100-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	50-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	10-YEAR FREQ. FLOOD ELEVATION (M.S.L.)
18.42	1974.7	1974.0	1973.6	1971.0
18.72	1975.2	1974.4	1973.9	1971.6
18.74	1975.9	1974.8	1974.2	1971.7
19.06	1976.2	1975.1	1974.5	1972.6
19.86	1981.1	1980.3	1979.7	1978.6

APPENDIX G

INVESTIGATION & ANALYSES

Surveys

A bench mark circuit was established throughout the study area using existing U.S.G.S. Coast and Geodetic Bench Marks. Elevation reference marks are scattered throughout the study area. These reference marks can be used to determine flood elevations as indicated in this flood hazard analyses. Detailed locations, descriptions and elevations can be obtained from Appendix J. Third order levels were used as the base of accuracy in field surveys.

A total of 40 channel and flood plain cross sections, covering a channel mile distance of 15.17 miles, were analyzed.

The geometry of all bridges and culverts were measured and used in computing the water surface profiles.

All cross sections are located on the photomaps (Appendix B, Sheets 1 to 19).

Photogrammetry

High level aerial photography flights were flown in October 1982. This photography was used for compilation of the final photo maps. Field surveyed cross sections were used to compute water surface profiles for the 10-, 50-, 100- and 500-year floods. The 100-year and 500-year curvilinear flood boundaries were field mapped using elevations computed from water surface profiles.

Hydrology and Hydraulics

Peak discharges for the 10-, 50-, 100-, and 500-year frequencies were determined by procedures contained in Soil Conservation Service National

Engineering Handbook, Section 4 and Technical Release 20.

Peak discharges varied throughout the study area depending on the size and other characteristics of the contributing drainage area.

The drainage area at the beginning of the study area is approximately 161 square miles and reduced to 94 square miles at the upper end.

Water surface elevations for the 10-, 50-, 100-, and 500-year flood events were computed using the U.S. Soil Conservation Service WSP-2 computer program, which performs subcritical backwater computations by a modified step method. The program includes head loss computations at restrictive sections such as roadway bridge openings or culverts, using the U.S. Bureau of Public Roads Method.

Roughness coefficients (Manning's "n") used in the hydraulic computations were chosen using U.S. Soil Conservation Service guidelines. The channel value selected was 0.045, while the flood plain value ranged from 0.060 to 0.080.

Starting water surface elevations were computed using the downstream watershed slope.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in the study are shown on the maps.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly and do not fail.

The 100-year flood was computed to emphasize the effect of constrictions (bridge openings) on flooding and provide a basis for analyzing future improvements. Future projections indicate that expected encroachment will affect the flood stages a slight amount within the study area. The 100-year flood also serves as the base flood which HUD considers as a minimum for flood insurance requirements.

EXISTING BRIDGES AND CULVERTS

APPENDIX H

Bridges and culverts existing at the time of study and used to develop the water surface profile data contained in this document are shown pictorially on the following pages.

The pictures should be helpful in the future to visually check which bridging was in place at the time of study, which were restrictive or in need of replacement and which have been subsequently replaced thus affecting localized flood plains.

M10.22 Sections 25 and 26, T. 152 N., R. 90 W.

M10.26 Railroad Bridge in Section 25,
T. 152 N., R. 90 W.

M10.72 Sections 25 and 36, T. 152 N., R. 90 W.

M11.00 Quarter Line of Section 36,
T. 152 N., R. 90 W.

M11.65 (Hwy 37) Sections $\frac{31\ \text{R. } 89\ \text{W.}}{36\ \text{R. } 90\ \text{W.}}$ T. 152 N.

M11.93 Sections 30 and 31, T. 152 N., R. 89 W.

M12.27 Railroad Bridge in the SW¼ Section 30, T. 152 N., R. 89 W.

M13.62 Railroad Bridge in the SE¼ Section 30, T. 152 N., R. 89 W.

M13.70 Sections 29 and 30, T. 152 N., R. 89 W.

M15.27 Sections 28 and 29, T. 152 N., R. 89 W.

M16.89 Railroad Bridge in Section 27,
T. 152 N., R. 89 W.

M17.98 Raidroad Bridge in Section 22,
T. 152 N., R. 89 W.

M18.08 Sections 22 and 23, T. 152 N., R. 89 W.

M18.74 Railroad Bridge in Section 23,
T. 152 N., R. 89 W.

APPENDIX I

GLOSSARY

Acre-Foot -- The amount of water that will cover one acre to a depth of one foot. Equals 43,560 cubic feet.

Backwater -- The resulting high water surface in a given stream due to a downstream restriction or high stages in an intersecting stream.

Channel -- A natural or artificial watercourse with definite bed and banks to confine and conduct continously or periodically flowing water.

Cubic Feet Per Second -- Rate of fluid flow at which one cubic foot of fluid passes a measuring point in one second (cfs).

Discharge -- The rate of flow or volume per unit of time. In this report discharge is expressed in cubic feet per second (cfs).

Flood -- An overflow of water onto lands not normally covered by water. The inundation is temporary and the land is adjacent to and inundated by overflow from a river, stream, ocean, lake or other body of standing water.

Flood Frequency -- An expression of how often a flood event of a given magnitude will, on the average, be equaled or exceeded. The word "frequency" often is omitted in discussing a flood event for the purpose of abbreviation.

Examples:

10-year flood or 10-year frequency flood - the flood which can be expected to be equaled or exceeded on an average of once in 10 years; and which would have a 10 percent chance of being equaled or exceeded in any given year.

50-year flood - ....two percent chance...in any given year.

100-year flood - ...one percent chance...in any given year.

500-year flood - ...two-tenths percent chance...in any given year.

Flood Peak or Peak Discharge -- The highest stage or discharge attained during a flood.

Flood Plain, Flood Prone Area or Flood Hazard Area -- Land adjoining a stream (or other body of water) which may be temporarily covered by flood water.

Flood Plain Encroachment -- Placement of fill or structures in the flood plain which may impede flood flow and cause backwater.

Flood Proofing -- A combination of structural provisions, changes or adjustments to properties and structures subject to flooding for the reduction or elimination of flood damages to properties, water and sanitary facilities, structures and contents of buildings in a flood hazard area.

Flood Routing -- Computation of the changes in streamflow as a flood moves downstream. The results provide hydrographs of discharge versus time at given points on the stream.

Flood Stage -- The stage or elevation at which overflow of the natural banks of a stream or body of water begins in the reach or area.

Hydrograph -- A plotted curve showing the rise and fall of flood discharge with respect to time at a specific point on a stream.

Natural Storage Area -- In this report, refers to depressional areas, marshes, lakes and swamps that temporarily store a portion of the surface runoff.

Runoff -- In this report, refers to the portion of precipitation (including snowmelt) that flows across the land surface and contributes to stream or flood flow.

Stage Discharge Curve -- A plotted curve showing the variation of discharge with water surface elevation at a point on a stream.

Stage-Storage Curve -- A plotted curve showing the accumulated storage available for floodwater upstream from a point on a stream versus the stage at that point.

Valley Cross Section -- The relationship of the elevation of the ground to the horizontal distance across a valley perpendicular to the direction of flow.

Watershed -- A drainage basin or area which collects and transmits runoff to the outlet of the basin.

Watershed Boundary or Drainage Boundary -- The divide separating one watershed from another.

Water Surface Profile -- The relationship of water surface elevation to stream channel elevation at points along a stream, generally drawn to show the water surface elevation for the peak of a specific flood, but may be prepared for conditions at any given time.

ELEVATION REFERENCE MARKS

EAST FORK SHELL CREEK FLOOD PLAIN MANAGEMENT STUDY

R.M. No.	Elevation (MSL)	R.M.'s Description
4A [1]	1896.31	Chiseled X on NE wingwall of bridge over East Fork Shell Creek between Sections 32 and 33, T. 152 N., R. 90 W.
T-377 [2]	1911.046	A standard disk set on top of a concrete post approximately 1000 feet east of the SW corner of Section 27, T. 152 N., R. 90 W., 28 feet east of a railroad crossing and 42 feet north of the north rail.
W-227 [2]	1909.350	A standard disk set on top of a concrete post. Approximately 350 feet north of the SW corner of Section 26, T. 152 N., R. 90 W., 26 feet east of a railroad crossing and 42 feet north of the north rail.
U-377 [2]	1913.421	A standard disk set on top of a concrete post approximately 700 feet west of the railroad crossing between Sections 25 and 26, T. 152 N., R. 90 W., 48.5 feet SE of a private rail crossing, 45.5 feet south of the south rail.
S-227 [2]	1924.373	A standard disk set on top of a concrete post 45 feet north of the north railroad of the Soo Line Railroad and 48 feet east of the center of fourth street in Parshall, North Dakota.
A-375 [2]	1932.509	A standard disk set vertically in the north face of the Farmers Union Elevator at Parshall, North Dakota. Near the Soo Line Railroad crossing at North Dakota Highway 37, 61 feet south of the south rail of the main track, 10.4 feet east of a doorway, about 4 feet above the ground.

1/ Reference Mark Established by S.C.S.

2/ Reference Marks Established by U.S.C. & G.S.

R.M. No.	Elevation (MSL)	R.M.'s Description
V-377 2/	1932.237	A standard disk set on top of a concrete post 140 feet east and 39 feet north of the north rail from the Soo Line Railraod crossing. Between Sections 29 and 30, T. 152 N., R. 89 W., about 11 feet lower than the track.
B-88 2/	1949.907	A standard disk set on top of a concrete post, from the Soo Line Railroad crossing between Sections 28 and 29, T. 152 N., R. 89 W., 307 feet SW along the railroad and 74 feet SE of the southeast rail.
C-88 2/	1970.541	A standard disk set on top of a concrete post from the Soo Line crossing between Section 22 and 27, T. 152 N., R. 89 W., 62 feet southwest and 40.5 feet south of the south rail.
F-216 2/	1989.399	A standard disk set on top of a concrete post, approximately 650 feet west of the section line between Sections 23 and 24, T. 152 N., R. 89 W., 23 feet north of the north rail and 2.8 feet east of a telegraph pole.

2/ Reference Marks Established by U.S.C. & G.S.

APPENDIX K

BIBLIOGRAPHY AND REFERENCES

1. Hydrology - Section 4. August 1972. National Engineering Handbook. Soil Conservation Service. U.S. Department of Agriculture.

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3. Water Resources Data for North Dakota. Annual Reports. U.S. Geological Survey. Water-Data Report.

4. Extra Territorial Jurisdiction. North Dakota Century Code. Section 40-47-01. 1975.

5. Water Resources Council, United States. Regulation of Flood Hazard Areas, Vols. 1 and 2. Washington, D.C.: United States Government Printing Office, 1971 and 1972.

6. A Perspective on Flood Plain Regulations for Flood Plain Management. Department of the Army, Office of the Chief of Engineers, Washington, D.C. 1976.

7. Flood Proofing Regulations. DOA, OCE, Washington, D.C., 1972.

8. A Report by the Task Force on Federal Flood Control Policy, House Document No. 465 (89th Congress, Second Session).

9. Public Law 83-566 Watershed Protection and Flood Prevention Act.

10. Executive Order No. 11988, May 24, 1977, Flood Plain Management.

11. General Soil Map, Mountrail County, published by the Agricultural Experiment Station, North Dakota State University, Fargo, North Dakota, 1963.

12. Unpublished detailed soil map, East Fork Shell Creek, Mountrail County, North Dakota, USDA, Soil Conservation Service, 1983.